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TO THE

Cement and Engineering News

Vol. 25. January—December, 1913

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CHICAGO, JANUARY, 1913

THE CHICAGO CEMENT SHOW.

The sixth annual Chicago Cement Exposition which is to be held at the Coliseum during the week of January 16 to 24, promises to be of unusual interest to cement manufacturers and consumers of all trades, as the cement business is in an exceptionally flourishing state this year and as, for this reason, cement machinery will be bought freely and cement will be put to the widest application ever known.

More than 200 exhibitors will demonstrate to the visitors the progress made during the past year in concrete mixing machinery, in devices for the rapid and economic handling of concrete, in the artistic uses of cement and in a number of novel applications of concrete. Numerous models will serve to illustrate road building, the latest chapter in concrete construction, a branch of the building trade requiring extraordinarily large amounts of cement and, therefore, most widely discussed at the present time.

There will be plenty of surprises for every one and though you may have attended all of the former shows and may believe to be familiar with the ins and outs of the trade, it will be well worth your time to come to Chicago and to spend a few days among the exhibits.

SAND-LIME BRICK MANUFACTURERS' CONVENTION AT TORONTO.

The ninth annual convention of the American Association of Manufacturers of Sand-Lime Products was held at the King Edward Hotel, Toronto, December 3-4. This was the first time that the convention had been held in Canada and the meetings were attended by many of the leading manufacturers on the continent.

The sessions were presided over by Mr. S. O. Goho, of Harrisburg. The convention was called to order at 10 a. m. on the morning of December 3 by President Goho. This session was devoted to the registration of members, the presentation of reports and the appointment of special committees. The business session was continued in the afternoon. The papers presented on the first day were as follows: "Some Thoughts on the Development of the Sand-Lime Industry," by Mr. P. L. Simpson, Chicago, Ill.; "The Present Condition of the Sand-Lime Brick Industry," by Mr. W. H. Crume, of Dayton, O., and "Results of Testing Sand-Lime Brick," by Mr. Warren E. Emley, of the U. S. Bureau of Standards, Pittsburgh, Pa.

In the evening the members of the Association were entertained at a banquet by the city of Toronto and the Harbor Brick Company, after which a general business discussion took place.

On the second morning the delegates were the guests of the Toronto Sand-Lime Brick Company and the Toronto and Harbor Brick Company, and visited both plants. The afternoon was devoted to a business session.

The following officers were elected for the ensuing year: President, S. O. Goho, Harrisburg, Pa.; vice-president, F. B. Allan, Toronto; secretary, W. G. Plummer, Jr., Buffalo; treasurer, John L. Jackson, Saginaw, Mich., and an executive of five officers representing the various divisions of the association, as follows: Canadian, G. Sylvester, Calgary; Western, E. G. Chapman, Minneapolis; Eastern, W. M. Birchfield, Rochester; Central, L. W. Penfield, Willoughby, Ohio, and Southern, H. H. Tift, Tifton, Ga.

A change has been made in the name of the Association. It is now known as The Sand-Lime Brick Association. The next meeting will be held on December 9 and 10, 1913, at Harrisburg, Pa.

A supplementary report of this convention will be published in a later issue of this journal.

CONCRETE ROADS.

A resolution which we reprint from an Easton, Pa., paper shows one way in which enthusiasm for concrete roads is developed.

"Whereas, it appears that the concrete roads have been used for a greater length of time in Wayne county, Michigan, than elsewhere;

"Now, therefore, be it resolved, That the Board of Trade of the City of Easton does hereby recommend to the Hon. D. W. Nevin, Mayor, to the Councils of the City of Easton, and to the Commissioners of Northampton county, that a committee of inspection be appointed, which shall go to Detroit, Mich., and investigate the use of concrete for road making purposes and report in detail at an early date so that the City of Easton and County of Northampton may adopt this modern method of road making if it be found practicable.

"And be it further resolved, That a committee from this Board of Trade be directed to present a copy of this resolution to his excellence, the Hon. John K. Tener, Governor of the State of Pennsylvania, with the request that he direct the proper officials of his administration to investigate promptly the use of concrete as a road making material so that if practicable the State of Pennsylvania may adopt concrete for its new roads, and be it further

"Resolved, That the Easton Board of Trade invite the co-operation of the various business men's organizations in Northampton and Lehigh counties, Pennsylvania, and Warren county, New Jersey."

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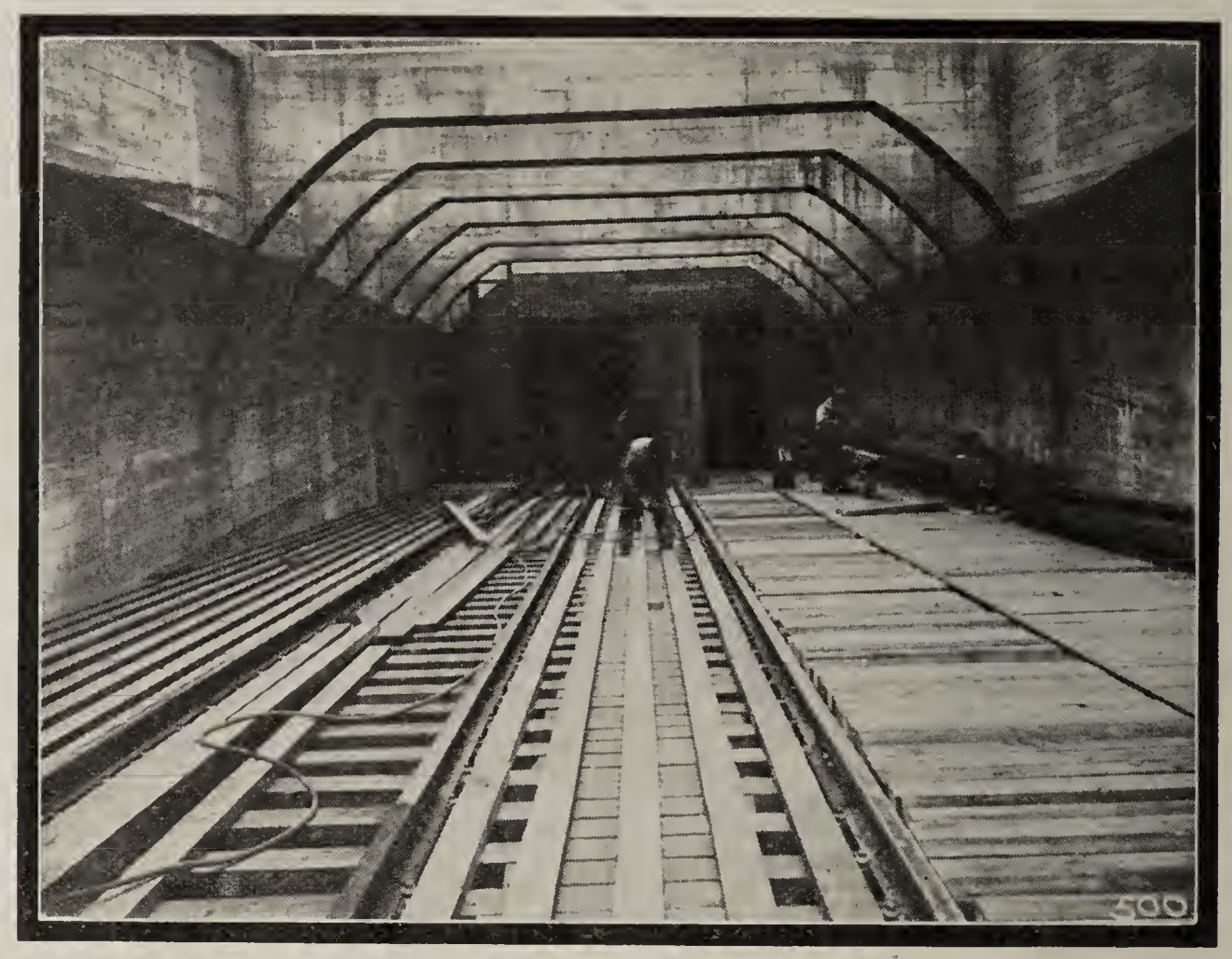
La Salle Street Tunnel Under Chicago River

Work on the new La Salle street tunnel, Chicago, Ill., is now finished. Residents living on the North side can now travel to the downtown district through a great bore constructed beneath the old tunnel in which a few years ago the cable cars bumped and rattled and jerked. The opening of the tunnel has marked the completion of the task imposed upon the city six years ago, when the United States Supreme Court April 9, 1906, upheld the decision of the Illinois Supreme Court directing the issuance of a mandamus writ to compel either the lowering or the removal of the Van Buren street, Washington street and La Salle street tunnels, which for years had obstructed the navigation of the river by deep draft vessels and had choked Chicago's commerce.



Laying Track in Open Approach—Concrete Struts Shown.
La Salle Street Tunnel, Chicago.

The La Salle street tunnel has many unique engineering features. It has been built with an eye to the future, the board of supervising engineers requiring a plan of construction that will render it available for subway uses when the city gets a subterranean transit system. Like the Washington street bore, the La Salle street tunnel will be used by the surface cars for the present at least. Underneath its preliminary approaches, however, are deeper approaches at proposed subway grade. On the inclines the surface cars will not travel on the bottom of the bore, but above its center line. Passengers will not see the full dimensions of the tunnel. It will be as deep beneath the rails as it is above them. If it is decided to use the bore for subway purposes when underground transportation becomes an actuality, there will be little trouble in linking it up at subway grade.

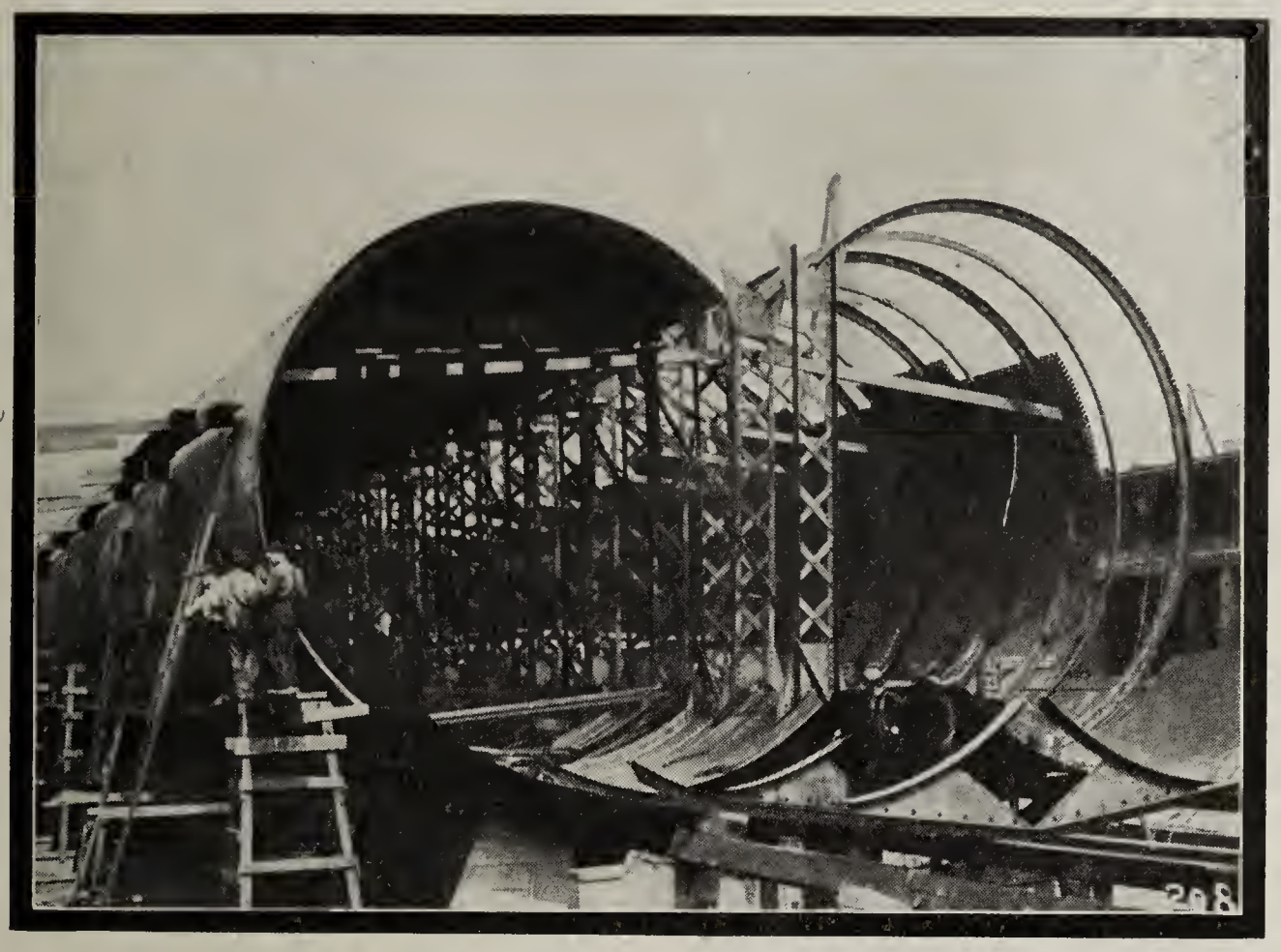
One of the notable engineering features of the La Salle street tunnel is the entrance arch at each side of the river. Each is forty feet in height on the inside and thirty feet wide. They are made of concrete reinforced with steel and are the largest arches of their kind ever constructed, according to the supervising engineers. They are so deep that if utilized for subway purposes they would give an approach of 3 per cent grade to the deepest section of the bore under the river. The preliminary approaches, which will be used by the surface cars, are built upon struts and reinforced scaffolds set on the bottom of the tunnel and give incline approaches of 9 per cent. A few hundred feet inside of the arch cinders have been used in filling the bottom half of the bore. They afford a solid roadbed and might readily be removed if the tunnel were transformed into part of a subway system. The preliminary inclines, which may be permanent approaches in case separate tunnels are built for the subway, will be about as steep as the east approach to the Washington street tunnel.

The cost of lowering the La Salle street bore is approximately $1,200,000, paid by the Chicago Railways Company under the terms of the traction ordinances. The work has been part of the rehabilitation of the surface lines and has been under the control of the board of supervising engineers.

The size of the La Salle street undertaking may be seen from the fact that the tunnel is almost twice the length of the Washington street tunnel. In general design it is a double bore tunnel, extending from Randolph street on the south to Michigan street on the north, a distance of 2,000 feet, and dipping under the river, which is 287 feet wide at La Salle street, at a depth that will give twenty-six feet five inches of water over the roof for a distance of 190 feet in the center of the river. At the dock lines the roof is twenty-three feet below the surface of the river. The tunnel contains two tracks, from the river section toward the ends the bottom of the tunnel maintains a 3 per

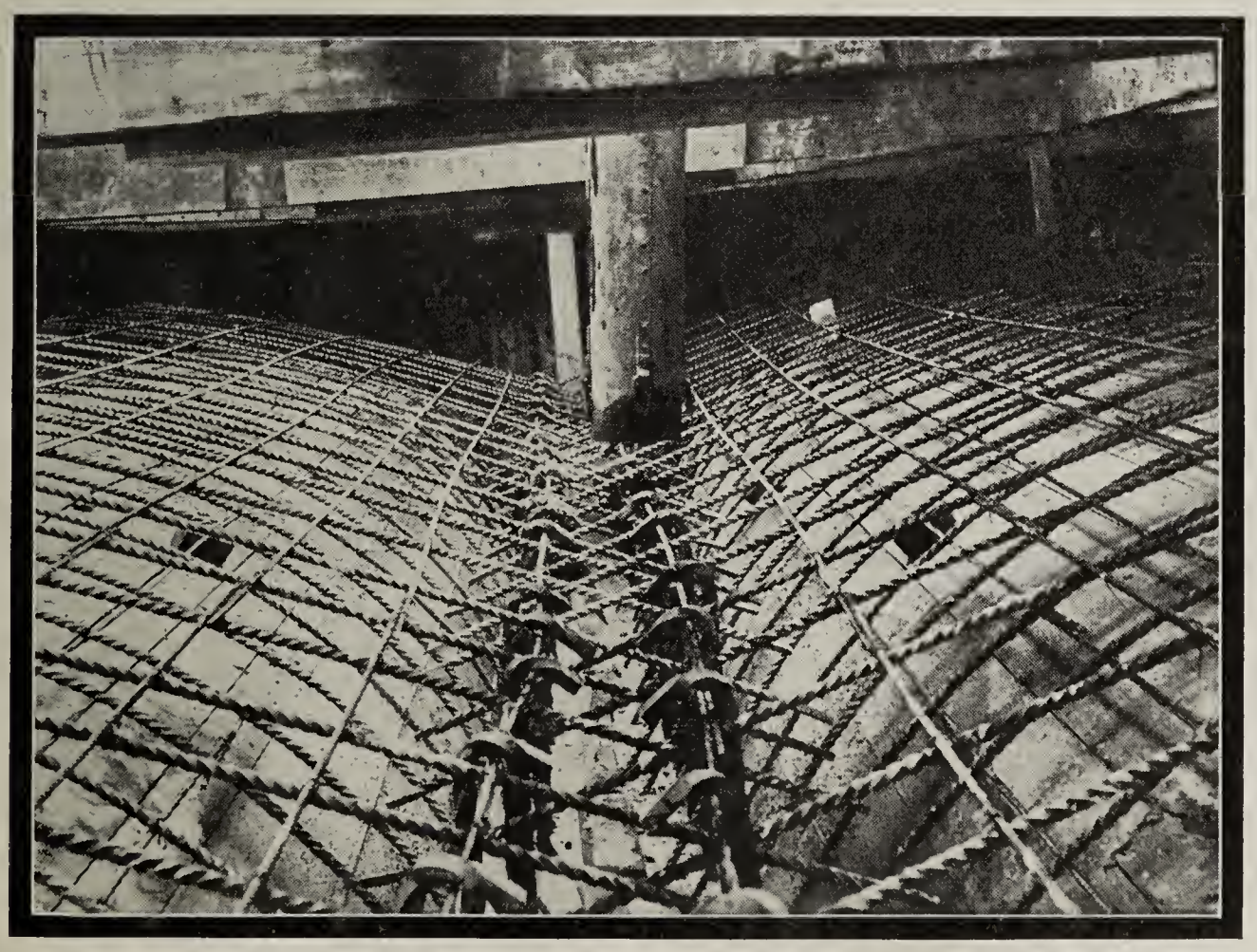
cent grade, while the temporary approaches have a 9 per cent grade to the point where they intersect with the tunnel floor.

The river section consists of a double-bore steel tube lined with concrete. These bores do not form com-



River Tube for La Salle Street Tunnel, Chicago, Showing Progress of Construction in Dry Dock

plete cylinders, as in the design of the tunnel at Detroit, nor are they incased in concrete. The design consists of two steel shells, each slightly larger than a semi-circle, and these two bores are separated by a wall of steel bars inclosed in concrete. The steel shell is not counted as a factor in the stability of the tunnel, an inside case of concrete being added to take all the stresses. This concrete lining varies from a thickness of 3½ feet in the invert to 2 feet at the crown. The only concrete on the outside of the steel shell is on the top, to level off the roof. The tube has been tested with a weight greater than would rest on the tunnel if it were filled with closely packed cars from one end to the other.



Reinforcing Steel Set Over Twin Bore Arch, South Approach, La Salle Street Tunnel, Chicago.

The shell itself was made on the bank of the river, and last April it was floated down to its place across the stream at La Salle street. The dams were closed

at Lockport for twenty-four hours, so that the river would have no current, and when the steel bore was sunk to the bed of the river the engineers had gauged it so nicely that it came within four inches of an exact north-and-south line. Four feet had been allowed. The steel case is 278 feet long, 27 feet high and 21 feet wide and is made of plates ⅜-inch thick, 7 feet 6 inches wide and about 19 feet long. It is stiffened by Z-bars bent to the required radius. The weight of the steel in the tubes is about 500 tons. In the construction 100,000 rivets were driven.

At one spot near Lake street the tunnel runs over the Illinois tunnel, and on the other side it crosses above an abandoned water tunnel. On both sides of the river sections of the original cable car tunnel and the passageway for pedestrians still remain. They are to be filled up with clay before the new route to the North Side is opened. The tunnel is lighted by arc lights suspended from the roof. Both trolley and light wires are fed by special feeders from two substations, so that power and light are assured at all times.

A separate conduit and water pipe tunnel, with a height of 11 feet and a diameter of 10 feet, is an auxiliary in which will be placed water mains and electric cables.

The history of the river tunnel reflects all the stages in the development of the transportation system in Chicago. The Washington and La Salle street tunnels were built by the city in the '60s for wagons and pedestrians. During the great fire of 1871, after the bridges were burned and twisted, they formed the connections between the business district and the North and West sides. In the late '80s, when traction companies contemplated a change from the old-fashioned horse car to the "rapid transit" cable system, the tunnels were turned over to the street railway companies for the use of the cable cars. Now they have been lowered for use by the rehabilitated traction system, and eventually they may be converted to the use of a subway. While the Washington and La Salle street tunnels are city property, the Van Buren street tunnel is owned by the Chicago Railways Company. It was built in 1893 on private property, and it is the shortest of the three river bores, its length, with approaches, being 1,517 feet, of which the tunnel proper is 1,052 feet.

WATERPROOFING CONCRETE FLOORS.

Concrete floors should never be treated or dressed until they are thoroughly dry and well seasoned, and the dressing should be applied before they have been supjected to traffic or wear. In some instances it is necessary to use an acid wash or some other neutralizing medium before applying any dressing to concrete floors.

When the concrete is thoroughly dry and seasoned, two coats of concrete floor dressing should be applied. Making a cement mortar veneer of one-half inch thickness, and applying two coats liquid cement upon the surface, after the same is thoroughly dry, produces a sanitary and light radiating basement.

Concrete floors having exceedingly fine, close texture, floated to a dense surface, which carry at times a semi-gloss finish, should be treated as follows: The surface should be gone over lightly with a carborundum rubbing brick in order to establish a bonding surface that will enable the concrete floor dressing to knit close to the floor structure and practically become integral with it. This will prevent scalping and peeling of the floor dressing. The floors should, of course, be cleaned, thoroughly dry, and well seasoned before the first or priming coat of concrete floor dressing is applied. Transparent floor dressing of any color desired may be used. It should be applied by means of a suitable brush, preferably a flat 5 or 6 inch white bristle brush. The dressing should be worked well into the pores of the concrete, spreading it well over the floor surface to develop a thin film. The temperature conditions during the periods of application and drying should not be under 70 degrees Fahrenheit to insure the best results. The second coat should not be applied until the first or priming coat is thoroughly dried, which under proper temperature conditions requires from two to three days. The second coat should be brushed out evenly and uniformly over the surface in the same manner as one would apply a finishing coat of floor varnish, and it should be given from four to six days for thorough hardening. Two coats develop a very satisfactory result, though three coats should be used where floors are submitted to unusual wear, such as floors that are used as passages, aisles, and runways, over which heavy trucking is done.

Concrete floors of exceedingly coarse texture should be cleaned, thoroughly dry and well seasoned before the first or priming coat of floor dressing is applied. Either the transparent floor dressing or any color desired may be used, and should be applied by means of a suitable brush, such as is described for its use on concrete floors of fine texture. The dressing should be worked well into the pores of the concrete in order to bond and bind it thoroughly. The temperature conditions during periods of application and drying should not be under 70 degrees Fahrenheit to insure the best results. After the first coat is thoroughly dry all surface areas or spots which may show unusual absorption or penetration or floor dressing should be "touched up" or gone over with an additional coat of dressing, in order to prepare a uniform surface for the finish coat. After the first coat is thoroughly dry, the finishing coat should be applied, brushing same out evenly and uniformly over the surface, as described in the specification for concrete floors of fine texture. The finishing coat should be allowed to harden from four to six days.

Concrete floors of irregular texture by which expression is meant those floors which are made up of extremely fine and extremely coarse texture, laid irregularly, which is sometimes due to carelessness, but often to unforeseen conditions—should be given a joint application of the specifications described for concrete floors of fine texture, and concrete floors of coarse texture.

Concrete floors of normal, uniform texture should be cleaned, thoroughly dry, and well seasoned when the first or priming coat of concrete floor dressing is applied. In this instance, as well as others, the transparent floor dressing, or any other color desired may be used, and it should be applied by means of a brush, and worked well into the pores of the concrete, spreading the surplus well over the floor surface to develop a thin film.

Floors which are laid in colors, such as terra cotta, green, etc., or where inert colors are mixed throughout the cement veneer or wearing surface, after being thoroughly cleaned, dried and well seasoned, should be given two coats of transparent floor dressing, applied under the same conditions as is described for the normal or uniform texture.—American Roofer.

The Ideal Concrete Manufacturing Company, Peoria, Ill., recently organized, has incorporated with a capital stock of $5,000.

Reinforced Concrete Culvert Pipe

From the report of a committee presented at the annual convention of the American Railway Bridge and Building Association, Baltimore, Md., Oct. 15, 1912:

Several roads are already adopting reinforced concrete culvert pipe for standard culverts under fills of all heights. There is no difficulty in designing reinforced concrete pipe to meet all conditions of loading, to secure sections with diameters up to 48 ins., the weight of which will permit handling by the same methods by which cast iron pipe is placed. Several miles of such pipe are being laid on the C., M. & St. P. Ry. this summer in connection with double track construction and change of line. Concrete pipe is used instead of cast iron as far as the available supply permits, except in the extension of existing culverts or at points where the thinner cast iron pipe is more convenient, as in replacing a timber box culvert.

Possibly, in mountainous country where pipe would be laid on steep grades, the attrition of sand-bearing water at high velocities might cause trouble with this class of pipe, by gradually scouring away the invert and exposing the reinforcing. Where timber trestles are being filled and the drainage area is such as can be cared for by a pipe, generally the most economical opening to provide is a reinforced concrete pipe up to a diameter of 48 ins. For openings larger than this some form of culvert built in place will be cheaper. The question of available material and length of haul will, of course, influence the type of opening used; however, an investigation showed that on the C., M. & St. P. Ry., even with carload tariff rates, a haul of 570 miles could be incurred and still make it economical to use the concrete pipe rather than cast iron. Aside from questions of cost, a properly reinforced pipe will be more apt to fail gradually in the event of breakage under the fill than will cast iron pipe. So far, however, no failures have been reported.

There is considerable variety in the types of pipe used and in the general dimensions and manner of reinforcing. For convenience in handling, the 6-ft. section adopted by the C., M. & St. P. Ry. proves a desirable length and provides units of ready adaptation to varying heights of fill. Sections of this length up to 48 ins. in diameter are readily unloaded from cars without special appliances. The thickness of the pipe depends on the character and disposition of the reinforcement. In one type of patented pipe the reinforcement is disposed of so as to be situated in the region of tension throughout, the section being elliptical. Pipe of this kind must be placed with its major axis vertical, and while permitting the use of thinner walls, it is not as convenient to handle as circular pipe which does not require a special position in service.

Recent experience of the C., R. I. & P. Ry. in using the longer 8-ft. sections on new line construction, involving considerable team haul and transfer of pipe, would indicate that shorter lengths are preferable. On new line work on the C., M. & St. P. Ry. their standard pipe was found much more convenient than the bell-jointed pipe of longer section bought outside; and it was found much more costly to place the oval pipes than cylindrical ones, special difficulty being experienced in rolling the former into place over rough and wet ground.

Joints.

Most users of concrete pipe seem to adhere to the bell and spigot joints, similar to those employed with cast iron pipe. One form of the joint used is a modification of the bell and spigot, the bell having the same external diameter as the balance of the section and the wall of the spigot end being tapered, with a band locking the reinforcing of adjacent sections together, the recess occupied by the band being afterwards filled with mortar.

A pipe designed by Messrs. Graham and Andrews of the B. & O. R. R. has three pockets recessed on the outside of the pipe, which permit the wiring of anchors in adjacent sections together, the pockets afterwards being filled with mortar.

In the C., M. & St. P. Ry. standard pipe, the ends are beveled with the portions adjacent to the outer and inner circumferences square. This results in a pipe with exterior and interior surfaces flush throughout its length when laid, insures an even bedding and greatly simplifies the forms required, as it reduces them to plane cylindrical surfaces, the bevels being formed by cast iron rings which serve to space the interior and exterior forms. A pipe having a uniform external diameter is much easier to handle and unload from cars and can be quickly rolled off, while those having enlarged bells usually are loaded vertically, bell down, and are very cumbersome to unload on a main line without special equipment.

Reinforcing.

For the smaller sizes of pipe some form of woven wire fabric seems to be used mostly with built-up cages of light bars for the larger sections. For economy in handling some form of reinforcing that will build up a stiff cage that can be handled and set in the forms without collapsing is desirable. In building the cages for the C., M. & St. P. Ry. type, experience showed that by wiring alternate hoops to the longitudinal reinforcement in opposite directions a stiff cage resulted, while if wired in the same direction, it readily collapsed when laid on its side. The specifications do not differ materially from those required in any other highly reinforced concrete construction, a 1:2:4 mixture with stone of 1 in. maximum diameter prevailing.

Seasoning, Etc.

A period of 30 days for curing before putting pipe in service seems desirable, though in summer this may be reduced to 20 days. One manufacturer writes that he had trouble with pipes which were shipped when 10 days old, due to the development of fine hair cracks, and that they now would not permit their pipe to be shipped out until a month old.

Pipe can be unloaded by skidding from cars with snub lines and can be rolled down embankments, with less danger of breakage than cast iron pipe. In some instances pipe is simply dropped off the cars and allowed to roll down the banks. Methods in general are the same as those used for unloading cast iron pipe, though some roads use derricks to handle the larger sizes.

Practice varies regarding filling the joints, some cementing them and others simply depending on the fit of the sections. It does not appear necessary under ordinary conditions.

Little information was received in regard to the type of forms used, except that steel forms were considered superior to those of wood. On the C., M. & St. P. Ry. wooden forms were used when the manufacture was first started, but these are being discarded, as they wear out, and are replaced by steel forms of the company's own design, and which are proving

very satisfactory. About one year's steady service was found to be all that could be gotten out of wooden forms, and the steel forms are much more economical.

Economy.

There is practical unanimity regarding the saving effected by the use of concrete pipe in place of cast iron, the relative cost depending on local conditions, but being from 25 to 50 per cent less. The economy is more marked with increase in diameter. With cast iron at $28.00 per ton, and the market quotations for manufactured concrete pipe, the following shows the relative costs per lin. ft. for the two kinds:

	24 in.	30 in.	36 in.	48 in.
Cast iron	$2.23	$3.33	$4.66	$8.26
Concrete	2.00	2.80	3.15	4.50

Very few railways have had concrete pipe in use many years. The Wabash Ry. has had pipe in service for five years and no failures have been observed here or elsewhere where the pipe have been properly handled and placed.

Committee: L. D. Hadwen, H. H. Decker, R. O. Elliott, F. O. Draper, F. E. King and G. Loughnane.

Extracts from Letters Received.

A. M. Van Auken, Chief Engineer, Arkansas Southeastern R. R.—We had a piece of construction where we desired to put in something more permanent than wood boxes and we used reinforced concrete pipe, solely because of cost. The freight charges made cast iron and vitrified pipe unduly expensive on that job.

Below are the estimated costs per lin. ft.:

Size.	Cast iron.	Vitrified.	Reinforced Concrete.
12 in.	$2.44	$0.30	$0.24
18 in.	5.43	.69	.50
24 in.	8.13	1.41	1.04
30 in.	10.86	2.04	1.32
36 in.	14.63	3.41	1.65
42 in.	19.50	....	2.30
48 in.	23.56	....	2.75

On this work sand and gravel were of easy access, while the cost of hauling was rather excessive.

J. F. Parker, General Foreman, A., T. & S. F. Ry.—We have been using reinforced concrete pipe for about two years for culvert work. The cost of laying per lineal foot varies a great deal, according to the conditions. For instance, if the pipe is to be placed in a fill 10 or 12 ft. high, the largest expense would be in excavating and back filling. We build concrete end walls for this pipe, costing according to the number of yards of concrete in the wall and the size of the pipe. We handle the pipe by hand, lowering it off the car by means of ropes, so as to let it down the bank easily. A pipe should not be placed under a fill until it has reached the age of from four to six weeks. It is our practice to fill joints. We have been using this pipe about two years and have not had any failures. The cost of the pipe is as follows:

12-in. pipe.....$0.65 per ft.
48-in. pipe..... 3.25 per ft.

The intervening sizes cost in the same proportion.

G. W. Andrews, Inspector of Maintenance, B. & O.—Instead of using the form as designed by us we are arranging to use the forms as made by the Blaw Centering Co., of Pittsburgh, Pa. No particular advantages are claimed for this pipe over that of the bell-end concrete pipe, other than there is larger space at the joints to take care of pulling than there is in bell-end pipe. We have made quite a lot of pipe of 36-in. diameter at a cost of $2.00 per lineal foot, which is approximately about one-third the cost of cast iron pipe and probably one-third less than the price paid manufacturers for concrete pipe.

G. W. Hand, Assistant Engineer, C. & N. W.—This company uses reinforced concrete culvert pipe under average conditions. The pipe is made under the following specifications:

Concrete.—1 part Portland cement, 1½ parts torpedo sand, 1½ parts gravel or crushed stone passing ¾-in. ring. Tensile strength of concrete, after seven days in water, to be 175 lbs. per sq. in. at 70 deg. F.

Reinforcement.—24-in. Pipe: No. 23 triangular mesh bent to circular form and adequately wired at splice with 6-in. lap. Longitudinal reinforcement to consist of 12 three-eighths in. bars spaced equidistant center to center and bent to extend into the bell and within 2 ins. of the surface of the end.

36-in. Pipe: Transverse reinforcement consists of ⅜-in. corrugated bars spaced 4 ins. center to center. These bars are bent to a circle and a splice is made by lapping the ends 9 ins. and wiring. Joints to be at quarter points. The longitudinal reinforcement consists of bars of the same size bent to extend into the bell, 12-in. bars being used. The bell is reinforced with two bars on the same size spaced 3 ins. apart.

42-in. Pipe: Transverse reinforcement consists of ½-in. corrugated bars spaced 4 ins. apart. Longitudinal bars of the same size, 16 being used. The bells are reinforced with two ½-in. bars spaced 3 ins. apart. All laps in annular rings to be staggered.

The total cost of these pipes is as follows:

Size.	Material.	Manuf'tur'g.	Placing.	Total.
24 in.	$0.40	$1.70	$1.45	$3.55
36 in.	.62	2.60	2.05	5.27
48 in.	.86	3.85	3,42	8.13

This indicates that the cost of the pipe varies from 70 per cent in the case of 24 in. to 50 per cent in the case of the 48-in. size of the cost of cast iron pipe at $26.00 per ton. The cost of placing is greater than the cost of placing cast iron pipe. The loss from breakage is greater, but on the whole reinforced concrete pipe shows a saving over cast iron pipe of about 25 per cent in first cost. The question of durability has not been determined.

A. Montzheimer, Chief Engineer, E., J. & E. Ry.—The E., J. & E. Ry. has adopted the use of reinforced concrete pipe for culverts in place of cast iron pipe for all openings where they will not be greater than 48 ins. in diameter.

The diameters inside and outside are as follows:

Inside diameter.	Outside diameter.
24 in.	34 in.
36 in.	48 in.
48 in.	60 in.

The sections are 8 ft. long with bell and spigot.
The 24-in. diam. weighs 2,800 lbs., or 350 lbs. per ft.
The 36-in. diam. weighs 4,200 lbs., or 525 lbs. per ft.
The 48-in. diam. weighs 5,600 lbs., or 700 lbs. per ft.

On account of the weight of concrete pipe we have found it necessary to handle it with a derrick and work train. We have a 10-ton steam derrick in the bridge and building department that is used for this purpose. With cast iron pipe no work train service is required, as the pipe can be rolled from a flat car without danger of breaking, and all sizes can be handled with a hand winch and tackle. We have had concrete pipe in service for about one year without failure of any kind.

I quote the following note from W. B. Hotson, chief draftsman, under date of December 14, 1910: "I find that for both the 36-in. and 48-in. pipe the medium weight cast iron pipe is the stronger, the 36-in. cast iron pipe being 1¾ times as strong as the 36-in. reinforced concrete pipe, and the 48-in. medium weight cast iron pipe about 1½ times as strong as the 48-in. reinforced concrete pipe. On the prints of the 24-in. reinforced concrete pipe there is not sufficient data for figuring its strength in that the amount of steel used is not shown."

F. O. Draper, Superintendent of Bridges, Illinois Central.—We have been using concrete pipe for the past three years with the very best results. I do not think that we have had but one culvert that has caused any trouble. This was on a very heavy fill and was filled by plowing off the cars, the material dropping a distance of about 30 ft. We had one pipe which crushed. This proved, however, to be a defective pipe.

Before starting to use these pipes we had a test made at the University of Illinois of the strength of the concrete pipe, also of the cast iron pipe of the same size, 48 ins. in diameter. The test was made by putting the joint of pipe into sand and tamping it thoroughly over the pipe, and by using hydraulic pressure for loading. The concrete pipe broke at 260,000 lbs. and the cast iron pipe, placed in the same manner, broke at 240,000 lbs. After the concrete pipe was broken it took the same load that it took to break the cast iron pipe, 240,000 lbs., before it went to pieces, which shows a considerable difference in strength between the two classes of material.

I believe that the concrete pipe is stronger and more durable and is about 50 per cent cheaper than the cast iron pipe. Of course, concrete pipe is more difficult to handle than cast iron pipe. In handling concrete pipe it is necessary in most cases to unload them with derrick cars and place them as near as possible in their final position with this equipment, as it is not practicable to roll them off cars the same as one would roll off cast iron pipe. I would not recommend installing this class of culverts smaller than 30 ins., or larger than 60 ins. In sizes below 30 ins. it would be better and cheaper to use cast iron, and above 60 ins. it is better to build a different style of structure.

E. Langford, Acting Chief Engineer, New York, Westchester & Boston.—This company has used 1,800 ft. of concrete pipe with a diameter of 48 ins. inside and 56 ins. outside, and a length of section of 8 ft. The pipe had bell joints and weighed three tons per section. The cost of placing in the open trench was $1.50 per lineal foot. The pipe have been in service for 12 months and no failures have been observed. It shows a saving of about 25 per cent over cast iron pipe.

G. W. Rear, General Bridge Inspector, Southern Pacific Co.—We use non-reinforced concrete culvert pipe under all conditions where it is large enough to carry the water, except that the pipe must be at least 3 ft. below the top of the tie.

We use pipe of the following sizes:

Inside diameter.	Outside diameter.	
12 in.	16 in.	
12 in.	24 in.	special for drainage close up to rail.
18 in.	24 in.	
24 in.	32 in.	
30 in.	40 in.	
36 in.	48 in.	

The sections are 36 ins. long. A modified bell and spigot are used, and where the thickness of the wall is sufficient the bell is formed in the wall itself. Where the wall is thinner it is flared out.

The approximate weight per 3-ft. lengths is as follows:

12 in.	300 lbs.
12 in. special	1000 lbs.
18 in.	600 lbs.
24 in.	1050 lbs.
30 in.	1650 lbs.
36 in.	2350 lbs.

The actual cost of handling and placing is a very small part of the job and is very little greater than for cast iron.

Concrete pipe costs us as follows, compared with the cost of cast iron pipe in the market:

Size.	Concrete.	Cast iron.
12 in.	$0.40 ft.	$1.80 ft.
18 in.	.50 ft.	2.80 ft.
24 in.	.70 ft.	4.00 ft.
36 in.	1.25 ft.	9.00 ft.

The cost of handling is not much greater than with cast iron. There is a little more excavation in a fill on account of the outside diameter of the pipe being larger and the pipe has to be handled a little more carefully. We have hundreds of these pipe culverts in all kinds of climate, and they are very satisfactory.

W. T. Powell, Superintendent of Bridges and Buildings, Colorado & Southern Ry.—We have used a great deal of concrete pipe built in one piece on the ground and reinforced with woven fence wire. The cost is about as follows, including head walls, excavation and all material:

36 in. diam., 8 in. thick.....5.00 lin. ft.
42 in. diam., 8 in. thick.....5.50 lin. ft.
48 in. diam., 8 in. thick.....6.50 lin. ft.

Oscar I. West, Manager, American Concrete Pile & Pipe Co.—We recommend that the pipes be loaded in such a way as to enable the section men to roll them from the cars, our belief being that pipes properly made and cured may be handled with much less danger of breakage than cast iron, simply by the use of skids and a snub line. We have had a standing offer to replace any pipes free of charge which have been broken in handling, and we have never been called upon to replace any except in the case of where some pipes were shipped which were not properly cured.

It has come to our attention frequently that pipes are pushed from the sides of the car and allowed to roll down the bank without the use of any skids whatever, and, so far as we know, with no injurious effect to the pipe. We have standing instructions with all our foremen not to ship pipes until they have had at least one month seasoning. In the summer of 1911 under stress of urgent appeals from railways to furnish them pipe, we permitted some to go out which had been cured but ten days. These pipes were sent out from three different plants to three different railways, and the experience was the same in each case, namely, that the concrete appeared to be filled with fine hair cracks so that as soon as the pipe were put under a load they broke. We did not ship very many of them before discovering this, and on giving them the proper time to season we had no further difficulty.

F. E. King, Assistant Engineer, C., M. & St. P. Ry.—The question of making concrete pipe had been under consideration for some time, but no definite move was made until July, 1911, when an experimental plant was started in Tomah, Wis. At first the plant was equipped with only two forms. These forms were of steel construction; one of them for 24 in. and the other for 30-in. pipe. Later on three 24 in., three 30 in. and six 36-in. additional wooden forms were provided.

As the pipe are built in a vertical position, they rest on the form that moulds the spigot end of the pipe. It was therefore necessary to furnish about three times as many bottom plates as forms. These additional end forms were for the most part constructed of wood. One cast iron bottom plate and one cast iron top plate were, however, furnished with each of the steel forms. The wooden forms were lined with sheet steel of about 22 to 24 gage, although this is not indicated in the drawing.

Other equipment consisted of a Smith concrete mixer, and a locomotive crane which handled the forms, removed the pipe from the working platform and took them to the stock piles. This, however, required only a short time in the early part of the day and the crane was engaged on other work around the yard having no connection whatever with the pipe plant the balance of the time. The installation of this plant was begun July 12, 1911, and it was operated continuously until December 23, 1911. Provisions were made for housing the green pipe and keeping them warm while the weather was not too severe, but it was not thought advisable to carry on operations during the winter.

The pipe are circular in section, with an effective length of 6 ft. The over-all length is 6 ft. 2½ ins., the 2½ ins. being used for the joint. The 24-in. pipe has a thickness of wall of 4½ ins. and contains a single course of reinforcing in the center of the wall. The 30-in. pipe have walls 5½ ins. in thickness with a single course of reinforcing in the center of the wall. The 36-in. pipe is 4½ ins. in thickness with a double course of reinforcing. The 48-in. pipe are similar to the 36-in. pipe, except that the walls are 5½ ins. in thickness. No. 42 in. and 48-in. pipe were built during 1911. In 1912, however, some forms for these sizes were furnished and pipe made, or will be made before the season closes.

The concrete mixture in all cases consisted of one part of cement, two parts of sand and 4 parts of crushed rock. The rock used consists of all the particles held on a screen with ¼-in. openings that will pass a screen with 1-in. openings. The reinforcing employed during 1911 consisted of ⅜-in. round deformed bars.

The output of the pipe plant for 1911 consisted of 327 24-in. pipe; 352 30-in. and 260 36-in. pipe, a total of 939 pieces of all sizes. The total yardage of concrete used in these pipe amounted to 770 cu. yds., the sacks of cement used 5,360; crushed rock, 632 cu. yds.; sand, 379 cu. yds., and gravel, 106 cu. yds. The average number of sacks of cement per cu. yd. of concrete was 7.04 and the total pounds of reinforcing metal 111,845.

The force of men employed consisted of a foreman and seven men in July and was gradually increased from that number to a foreman and 17 men in December.

No. 42-in. pipe were constructed up to this date, as the forms for this size of pipe were not received until a later date. The equipment for 1912 was the same as that used in 1911, except that the concrete mixer used in 1911 has been replaced with a smaller machine driven by an electric motor and equipped with an elevating hopper; also most of the wooden forms have been gradually replaced with steel ones. At the end of September 7 24-in., 4 30-in., 1 36-in. and 4 48-in. steel forms, also 2 48-in. wooden forms, were in use, making a total of 18 forms of all sizes.

During weather in which the concrete sets rapidly, it has been possible to make a pipe per day with each form. Under favorable conditions, with the present equipment it is possible to make 18 pipe per day.

Concrete Culvert Pipe Plant, C., M. & St. P. Ry., at Tomah, Wis.

It has been found that the wooden forms get out of shape and in the long run are not as economical as the steel ones. They are, however, satisfactory as a temporary expedient. They also have the advantage of being lighter to handle than the steel ones. This fact is of some value where the handling of the forms is done by hand. This advantage, however, is to some extent offset by the additional number of pieces to be handled, and therefore the increased cost in time of setting them up.

It is the expectation to erect a permanent plant at Tomah for carrying on the manufacture of pipe for about nine months out of the year. This plant was to have been erected this year, but the pressure of other work has delayed the completion of the plans and the carrying out of the work. When complete this plant is to be equipped with labor-saving devices to insure the maximum output for the least expenditure of labor.

Specifications for Reinforcement of Concrete Culvert Pipe, Illinois Central R. R.

Cement.—Shall be of the brand or brands acceptable to and furnished in accordance with the specifications of the railroad company.

Workmanship.—Only workmanship of the highest quality shall be acceptable. Smoothness of finish and thoroughness of method throughout shall be required.

Aggregate.—The aggregate shall be of sand and crushed stone or gravel. All stone shall be of a sound, hard, clean stone crushed and screened so that none will pass through a sieve having ¼-in. meshes and so all will pass through a screen having meshes 1 in. in diameter. All gravel shall be clean and free from dirt, and preferably graded in size from sand to pebbles about 1 in. in diameter. All gravel shall be of a size which will pass a 1-in. screen. All concrete shall be mixed with the following proportions by loose measures:

Proportions of Stone Concrete.—Cement, 1½ bbls.; stone, 1 cu. yd.; sand, 0.45 cu. yd.; proportions of gravel concrete—cement, 1½ bbls.; gravel, 1 cu. yd.

Mixing.—When the amount of pipe is sufficient to warrant it, the concrete shall be mixed by machine. When mixed by hand the work shall be done as follows: The stone and sand or gravel shall be spread on a water-tight platform to a depth of 6 ins. on this the cement shall be evenly spread and the mass turned till of a uniform color. Water shall be added sufficient to make a plastic mass and the whole turned over and over till thoroughly mixed.

Deposition.—The most care shall be taken to prevent the formation of voids in any part of the pipe and to insure the thorough embedment of the reinforcement in its proper position until the concrete is placed around it. As the concrete is deposited, it shall be spaded or puddled along the lining of the mould on each face, so as to insure the smoothest possible finish. Every section shall be completely filled before any portion of the concrete has set.

Moulds.—The moulds shall be made true to plan and held rigidly in form during the process of depositing the concrete. They shall be lined with metal with all edges filleted and shall be well greased before each pipe is made.

Reinforcement, 60-in. Pipe.—The transverse reinforcement shall consist of ½-in. square deformed bars of 50.000 lbs. elastic limit spaced not more than 4½ in. center to center. These bars shall be bent to a circle and the splice made by lapping the ends for length of 9 in. and tightly wiring them together. The joints shall be placed so that they will come at the quarter points or points 45 per cent from the vertical or horizontal diameters of the cross section of the pipe and shall break joints so far as possible. The longitudinal reinforcement shall consist of bars of the same section as the transverse bars and shall be spaced 9 ins. apart, if round, or 12 ins. apart, if square. The longitudinal bars shall be suitably bent so as to extend into the bell and within 2 ins. of the surface at the end. The bell shall be reinforced by two transverse bars of the same size as the others, spliced in the same way. The transverse and longitudinal bars shall be tightly fastened together so as to hold them in place during the deposition of the concrete.

48-in. Pipe.—The transverse reinforcement shall consist of ⅜ in. square or round deformed bars of 50,000 lbs. elastic limit spaced not more than 3 ins. center to center, if round, or 3⅞ ins. center to center, if square. The longitudinal reinforcement and the bending and splicing shall be as described for the 60-in. pipe.

42-in. Pipe.—The transverse reinforcement shall consist of ⅜ in. square or round bars spaced not less than 3⅞ ins. center to center, if round, or 4¾ ins. center to center if square. The longitudinal bars shall be spaced 10 ins. apart if round or 12 ins. apart if square.

36-in. to 24-in. Pipe.—The reinforcement of these pipes shall consist of No. 23 American Steel & Wire triangular mesh bent to circular form and adequately wired at the splice with not less than 6-in. lap, together with ⅜-in. round transverse bars spaced 12 ins. center to center. These transverse bars to be so bent as to extend into the bell and within 2 ins. of the surface at the end. The reinforcement of the bell shall consist of 2⅜-in. round bars bent and spliced as described for the 60-in. pipe.

Alternate Plans for Reinforcement.—A circular concrete pipe having two lines of reinforcement may be used in place of the single-line reinforcement, above specified, providing the pipe is of equal strength to that above specified, and providing that in all cases the plan for the reinforcement, thickness of material, etc., is approved by the engineer.

TIFT SILICA BRICK.

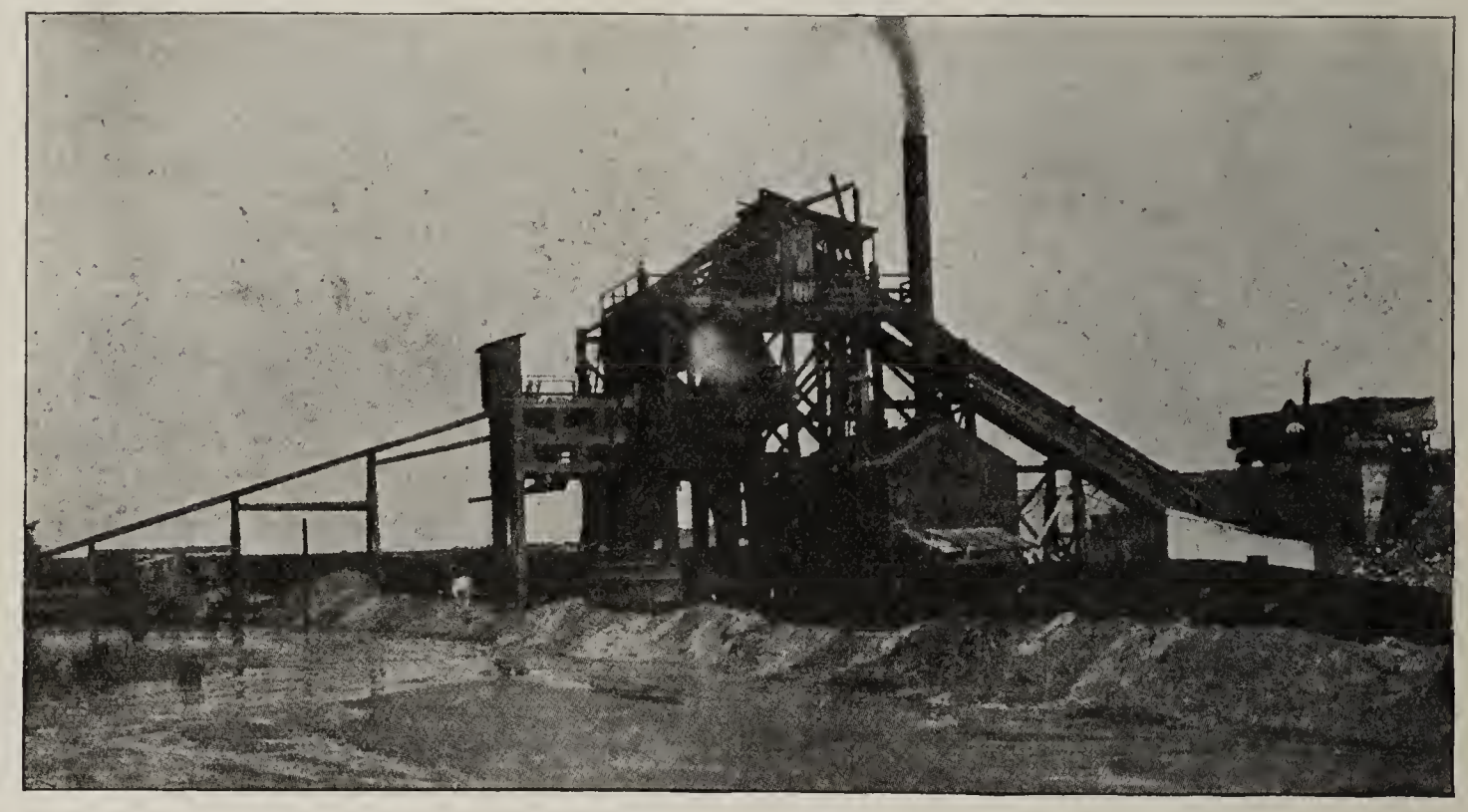
The Tift Silica Brick Co., of Tifton, Ga., reports they are three-quarters of a million brick behind in their orders. The company has issued a little booklet describing how the brick are made. It says:

The sand is fed from the bank into and is passed through a Direct Heat Rotary Drier in which it is subjected to an intense heat which drives off the moisture and burns up any impurities, such as roots, leaves, etc., to such a condition that subsequent application of heat causes no further contraction or expansion, thereby insuring a product of superior fire-resistant qualities. The sand is then elevated to a large tank or bin holding about ten tons alongside of which is another bin containing finely crushed lime. These bins are located above the mixing machinery and the sand and lime is fed by gravity on to measuring belts, which also act as conveyors. As the sand falls over the end of its conveyor-belt, it is divided into two portions. One part passes with all the lime into what is called a Tube Mill and is there ground to an impalpable powder—200 mesh fine. While this grinding is taking place, the balance of the sand, unground, is being carried into a second mill called the Pug Mill, where it is thoroughly mixed with the powder from the Tube Mill and is dampened with water. Only enough of the sand is ground with the lime to completely fill the voids between the larger grains of unground sand, so that when pressed a very dense brick is secured, which is non-porous and low in absorption. By the intimate mixing, each grain of sand is completely surrounded by a thin coating of the powder from the grinding mill, which has all the qualities of a quick hydraulic cement and, in a later stage of the process, creates a strong and perfect bond throughout the whole mass of material. In the second, the mixture is moistened and is carried by elevators to the third floor, where it is emptied into a large steel Silo where it remains over night to insure the perfect hydration of the lime. The next morning this raw material is automatically fed from the Silo into our huge sixteen-mold rotary press where it is pressed into brick. This press exerts an immense pressure of 80 tons to the square inch. As the "green" bricks come from the press they are stacked on steel cars and run into a Hardening Cylinder, six feet in diameter by seventy-four feet long, holding 20,000 brick, in which they are subjected to a steam pressure of 120 pounds to the square inch for ten hours. After this steaming they are ready to be laid in the wall—the whole process having required but forty-eight hours from raw material to finished product.

Gravel Washing Plant of the Richmond, Fredericksburg & Potomac and Washington Southern

By S. B. Rice, Engineer Maintenance of Way

About the time the double tracking of the Richmond, Fredericksburg & Potomac and the Washington Southern had been completed in the latter part of July, 1907, the officials were discussing the matter of using stone ballast to make the line first-class in every respect, as it is a through trunk line between Richmond, Va., and Washington, D. C., with a very heavy traffic. An average of 24 through passenger and 10 local trains are handled daily during the heavy season and an average of 20 through passenger and 10 local trains daily during the light season, the through trains consisting of from six to twelve cars and the local trains of from four to five cars. We also have an average of 20 freight trains daily throughout the year. The weight of the heaviest engine is 156,730 lbs. on drivers; and the total weight, 373,200 lbs.



View of Gravel Washing Plant, Showing Gravel Car and Hopper.

About this time a heavy deposit of very excellent gravel was discovered at Massaponax, Va., 57 miles from Richmond and midway between that point and Washington. The gravel lies in a bed from 10 to 20 ft. in depth, about 800 ft. wide and 4,000 ft. in length. The pit was estimated to contain about 1,000,000 cu. yds. of serviceable material, and was opened on August 22, 1907.

The pit-run gravel from this pit was used on portions of our track and made an excellent track, but in dry seasons it was found to be very dusty, and in wet spells the track became sloppy. In the latter part of 1907 we conceived the idea of washing and screening this material, as was done by the Lake Shore & Michigan Southern at Roupel and Pleasant Lake. In July, 1908, W. D. Duke, assistant to president; S. B. Rice, engineer maintenance of way, and E. M. Hastings, resident engineer, made a trip to the Roupel plant to look into the advisability of duplicating this plant, also to inspect track that had been ballasted with washed gravel. Mr. Duke was so much pleased with the condition of the track and plant that he at once recommended the installation of the washing plant at Massaponax at the earliest possible time. The authority for this work was given in the latter part of July, 1908. Work was at once started on this plant and pushed as rapidly as possible to have it completed before bad weather set in. The first shipment of washed gravel was made on November 20, 1908.

The plant consists of a large concrete hopper into which the pit-run gravel is dumped and from which it is carried by a pan conveyor having a speed of 30 ft. per minute, or 120 to 150 cu. yds. per hour, on an incline of 30 deg., to the top of the trestle some 45 ft. high, where it is discharged into a steel-lined box, 6 ft. by 3 ft. in plan and 1 ft. deep in front, or at the chute. The water is discharged from a flat nozzle, 1 in. wide and 24 in. long, connected to a 6-in. discharge pipe, and strikes the gravel as it falls into the box, washing it over a steel-lined chute, 6 ft. wide and 8 ft. long, with a slope of 3 in. to the foot. It was found necessary, in order to more completely wash the gravel, to place a series of rods across the chute, making the gravel tumble over them, thereby retarding its progress and obtaining a more complete washing.

At the end of the chute a double screen is placed at an angle of about 45 deg. with the chute. The screens are about 9 in. apart, and are of double-crimped tool steel wire. The first screen is of No. 6 wire, one mesh to the inch; the second of No. 10 wire, two meshes to the inch. All gravel that does not pass these two screens falls into the ballast bin, which is 36 ft. long, 12 ft. wide and about 12 ft. deep. The lower 6 ft. of this bin is sloped toward the center, so that the gravel will fall by gravity through the openings in the bottom.

All of the material which passes these two screens along with the water falls upon a second steel-lined chute which is 8 ft. wide, 9 ft. long, and has a slope

of 2 in. to the foot. From this chute the material is discharged against another screen of double crimped tool steel wire No. 12, four meshes to the inch. This screen takes out practically everything larger than ⅛ in. in diameter. All material which does not pass this screen falls into the ballast bin also.

The material passing the screen is carried over another steel-lined chute about 10 ft. wide and 7 ft. long, where it is discharged as sand into a settling tank about 12 ft. by 13 ft. and 3 ft. deep. On the side of the tank opposite this chute is the waste flume where the muddy water is carried off and discharged on the bed of gravel where the gravel had been previously excavated.

The settling tank is water-tight and is fitted at the bottom with two conical steel hoppers, 6 ft. in diameter at the top and 10 in. in diameter at the base, 5 ft. deep. The bottoms of the steel cones are fitted with a steel cone plug which makes them nearly water-tight. The plugs or cones are operated from the top. The idea of having two of the conical hoppers was to grade the sand, the coarse sand settling in the first hopper and the fine sand in the farther one, there being a distinct difference in the two grades of sand. For this sand we have found ready sale, as it is of excellent quality for building purposes and concrete work, the finer sand making excellent engine sand.

The ballast bin is steel-lined throughout and has three openings at the bottom, fitted with 20-in. by 20-in. rack and pinion valves, spaced so as to empty into the center and two ends of the ballast car, giving a uniform loading without necessitating the moving of the car. The material is distributed in the ballast bin about equally over the three openings.

The water is brought from Massaponax creek through a gravity canal, 900 ft. long, to a concrete-lined well, 7 ft. by 5 ft. and 11 ft. deep; the bottom of the well being 4 ft. lower than the creek at the intake. This canal is a 20-in. by 20-in. open wooden flume for 500 ft. where it runs into a 20-in. by 20-in. wooden box, covered by some 8 ft. of earth. This box is about 370 ft. long. Connection is made with an 18-in. terra cotta pipe, which runs under the engine foundation and the pull-out track into the well, which is located close to the engine; this flume is always submerged. The pump is an Emerson No. 4 pump, with a 6-in. suction, and is rated for a 5-in. discharge. The rated capacity is from 800 to 1,200 gal. per minute. To overcome friction it was fitted with a 6-in. discharge. The steam is furnished by a 90 h. p. return tubular boiler, which is under the same roof as the engine and pump. There is also a No. 5 pulling pump, rated at 350 gal. per minute, to pump water into a 25,000 gal. tank about 1,400 ft. distant for the use of ballast and spotting engines. This tank is located on the pull-out track, just north of the coal bin. At this point office and bunk houses are provided for both white and colored help, the bunk houses being separated. Steam shovel and spotting engine crews are provided with both lodging and board.

The concrete hopper, into which the pit gravel is dumped preparatory to washing, is 18 ft. above the foundation, 36 ft. long and 12 ft. wide inside, the outside walls being 2 ft. thick. The inside of the hopper slopes from the top on all sides toward the center opening, which is 18 in. by 20 in., and provided with a steel sliding door which governs the feed on the conveyor. The slant sides of the hopper are 6 in. thick, reinforced with from ½ to 1½-in. iron rods, spaced 18 in. on centers and bent over into the 2 ft. outside walls. They are fastened together with ½-in. rods spaced about 12 in. apart. The track on the hopper is carried on 12-in. by 14-in. wood stringers, one of which is immediately over the outside wall, the other carried on 12-in. by 14-in. cross stringers, spaced 6 ft. center to center, and imbedded in the outside walls. The track over the hopper is fitted with a bar screen, bars spaced 4½ in. apart, so as to prevent roots, stumps, boulders, or large lumps of clay from being carried to the washing plant.

The approach to the hopper is on a 2 per cent grade ascending, to a point 150 ft. from the end of the hopper, thence on a 1 per cent descending grade, over the hopper, after which it breaks into a 2.5 per cent descending, then to a 5 per cent descending grade for about 150 ft., then to an 18 per cent ascending grade. At the junction of the 5 per cent and 18 per cent

Ballast and Water Passing Over Bars.

grades a spring switch is located, the track leading away from the switch being on a descending grade to the pit level, the idea being to do most of the shifting by gravity. After being pushed up the 2 per cent approach to the hopper the loaded cars are unloaded, dropped down the 5 per cent grade by gravity, and up on the 18 per cent grade which gives them a kick back through the spring switch and down to the pit level, where they are taken by the engine to be reloaded.

It is intended to cover the 112 miles of double track with washed gravel, thereby securing a dustless roadbed. In order to accomplish this new grades were given, making a lift in track from 3 to 16 in., taking out some slight sags. Of course, where the track was lifted as much as 6 in. the old ballast could be worked under the ties, but at the other points the old sand and gravel ballast was thrown out to make roadbed. Ballast was loaded into the Rodgers drop bottom ballast cars and delivered in the track, using a Rodgers plow for leveling down. This work was carried on by an extra force, renewing all ties that were not good for two years, regaging track and properly spacing ties ahead of new ballast. The renewal of ties and regaging was charged to maintenance; surfacing track was charged to reballasting. It required from 3,200 to 3,800 cu. yds. of gravel to the double track mile.

The force employed at the pit consists of the following: One general foreman, one clerk, one shovel engineer, one craneman, one shovel fireman, four men at shovel, one engineer in charge of plant, one towerman who operates the machinery at the top of the plant, also looking after the screens, one foreman on hopper, one hopper and two helpers, one sand loader, one gravel loader and two droppers of cars. In addition to this there are three men on cars closing them up and calking and getting them ready for sand. Shifting track is generally done by the section force and is, of course, charged to pit expense.

Since the starting of the washing plant 371,877 cu. yds. of washed gravel have been shipped, of which 354,439 cu. yds. were used for ballast and 17,438 cu. yds. for concrete and other purposes. From this total amount of gravel has been taken 78,232 cu. yds. of sand, most of which has been sold for building purposes. Of course, the hauling of this has been revenue to the company. The cost per cubic yard of loading rough gravel was 8.95 cents; cost per cubic yard of washing gravel, 11.34 cents; cost per cubic yard for hauling, 11.11 cents; cost per cubic yard for placing in track, 26.15 cents; or a total cost of 57.55 cents per cubic yard of finished track. This cost includes hire of all engines, train crews, coal and supplies; rental of shovel, coal, supplies and repairs; 1 cent per cubic yard to cover cost of gravel in pit and 10 per cent depreciation on plant and tracks; but no credit is taken in these figures for sand sold.

We have found by actual test that the washed gravel is nearly self-draining; it will not retain over 11½ per cent of water, while the pit-run gravel will retain 55 per cent. It has been demonstrated that the washed gravel will withstand any amount of continued rain and not slop, while the pit-run would, causing rough track in continued wet spells. Aside from the better condition of track we estimate to add at least two years to life of the ties. It makes a dustless roadbed and reduces the cost of maintenance.

OHIO FARMER WELL SATISFIED.

The following is given by S. F. Haserot of Cuyahoga County, Ohio, in a recent issue of the Breeder's Gazette:

I have worked out a plan to build two 300-ton hollow concrete block silos. In the business of canning fruits and vegetables with which I have been identified for a number of years, a large quantity of good feeding material was apparently wasted each season, this being especially the case with peavines that went through the cannery after the peas were taken from the pod. It was arranged to build two silos, each 24 feet in diameter and 30 feet in height. After figuring exactly on the form of making the hollow blocks, we ordered these forms of one of our foundrymen and he made them so that the blocks could be made in segments. When the blocks were laid to the extent of the diameter proposed the forms were so accurately adjusted that the blocks came together within an eighth of an inch, making a clean circle, the slight opening at the end being closed up with a little additional cement.

The foundation was made of the diameter proposed, of the proper mixture of 6 parts coarse gravel to 1 part cement, thoroughly mixed. This foundation was built up to the level of the ground. The blocks were made of coarse sharp sand and cement mixed, 3 parts of sand to 1 part cement, this mixture being subject to the character of both cement and sand. The blocks were made with a hollow center and laid one after another around the foundation and up until the proper height was reached. A cone-shaped roof was added, thus completing the structure. The inside after the blocks were all laid was smoothed and painted over with pure cement paint.

In building a hollow concrete block silo great care should be exercised in getting the proper mixture of cement, gravel and sand in order to make a solid serviceable block. When the silos were completed a sufficient time was allowed for the blocks thoroughly to dry out and they were then filled to the top with peavines, a quantity of water being allowed to go into the silo with the vines, thus packing the silage down solidly. In order to avoid an excess of water a cement cistern was built underneath the ground and outside of the wall of the silo into which the excess water passed, and from this cistern the liquid was pumped out and distributed on the farm.

To build a concrete hollow block silo one must be willing to calculate on a greater cost than the amount that it would be necessary to invest in any kind of a stave silo, but in the northern climate especially the hollow block silo is desirable because there is then no danger of spoilage on account of the freezing of the contents around the inside wall.

Recently I had occasion to examine the silage which was taken from the center of the silo after it had been filled for six months, and the fodder came out in perfect condition, so much so that my Herefords eat up clean every day their ration of 40 pounds and seemed willing to eat more.

A careful record of the cost of a silo of this kind, 24 feet in diameter and 30 feet high, allowing for the cost of average labor at 20 cents per hour, and figuring the value of a man and team at $3 per day, is $550 complete, including roof and cement cistern underneath. While the initial cost is possibly 40 per cent more than the cost of a stave silo there is very little expense for painting, and the repairs for a number of years will be very light indeed. In view of my experience I should certainly recommend those who are considering the idea of building a large silo to consider one made of concrete hollow blocks.

DUST COLLECTORS AT CEMENT PLANTS.

There have been a number of instances where the dust occasioned by cement plants has been objected to by the owners of surrounding property, as tending to injure growing crops. One such case was that of the Southern Cement Company at Birmingham, Ala., which, two years ago, was seriously troubled on account of the dust made by their dryers. This matter became so serious that injunctions were gotten out against the company, threatening the very life of the business. The matter was therefore taken up with various manufacturers of dust collectors and systems, but the company deemed the guarantees insufficient and all proposals were rejected, and the experts of the company decided to work out a plan of their own. The result was the production of two collectors, known as the Douglas dust collectors. Each of these was connected with a dryer. Each collector gives approximately a ton of dust a day. The cost of operation is merely the power required to drive the fan, and the repairs in two years have ben practically nothing. These dust collectors were manufactured by the Schaeffer Manufacturing Company, Birmingham, Ala., with whom any one desiring equipment in this line can correspond.

The Manufacture of Gypsum Products.

An Important Industry at Lythmore, Ont.—Excellent Facilities of the Crown Gypsum Company, Limited—Personnel of the Firm.

Lythmore, Ont., will shortly be the home of an important industry—the manufacture of gypsum products—which will be carried on by the Crown Gypsum Company, Limited, with every promise of, and everything conducive to the development of Dominion-wide connections.

This concern was organized under the Ontario Companies Act in February, 1908, with a capitalization of $100,000. Shortly afterwards a small mill with one 8 ft. kettle was built alongside the main line of the Michigan Central railroad at a station then known as York Mines, but since changed to Lythmore. Mining and manufacturing were carried on in a small way until July, 1911, when the mill was totally destroyed by fire. Since the fire the company has been partially reorganized and the stock has been increased from $100,000 to $200,000, all of which has been sold and paid for at its par value.

In the spring of 1912, Mr. H. J. Brown, formerly Assistant Manager of the United States Gypsum Company, Chicago, purchased an interest in the company and severed his United States connection, taking over the management of the Crown Gypsum Company, Limited. Mr. Brown was with the United States Gypsum Company for ten years and is thoroughly versed in the gypsum business.

The company now proposes to manufacture a complete line of gypsum products, such as cement plasters, wood fibre plasters, finishing plasters, plaster of Paris, land plaster, plaster board, fireproof gypsum partition tile and crushed gypsum rock for use in Portland cement. Nothing in the line of gypsum products will be overlooked.

To replace the old mill destroyed by fire a new fireproof mill has been built. The main mill building is of brick, steel and concrete construction throughout, as a safeguard against a repetition of the fire of 1911. Additional safeguards will be furnished in the way of approved fire doors and it is proposed to protect those portions of the building used for the storage of bags and supplies with a thorough system of automatic sprinklers of the dry pipe type, served by a large tank independent of the mill structure. This tank will also serve sprinklers to be located in the packing house and mixing room, as well as all other buildings that are not of wholly fireproof construction.

The equipment throughout the mill is of the most modern type. All of it has been designed and built especially for the work by the company's own engineer, experience having shown that the machinery usually supplied by manufacturers of plaster mill machinery has been rather too light for the duty required.

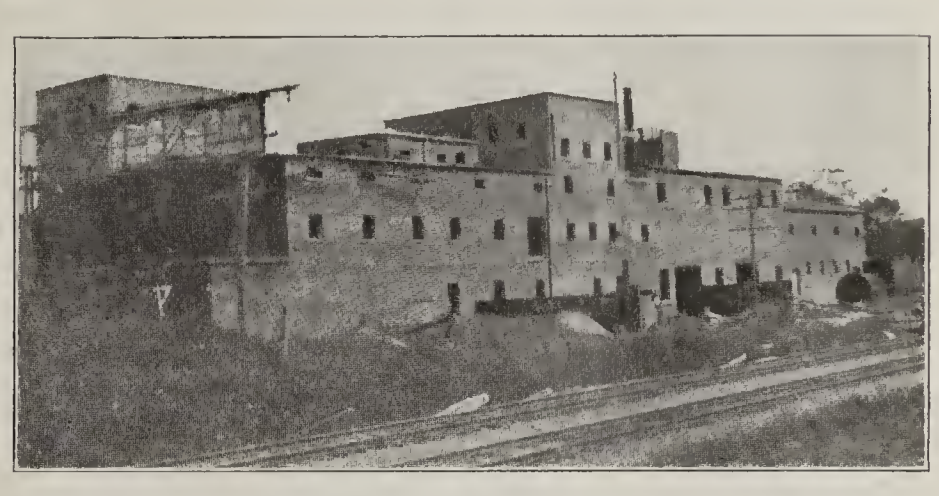
All the machinery is electrically driven by a combination of individual and group drives so located that the different processes of manufacture are independent of one another, this arrangement facilitating the most economical operation.

Electric power is obtained from the Hydro-Electric Power Commission of Ontario at 13,500 volts from the Dundas sub-station, and is delivered by the Commission to the company's transformer station where it is stepped down to 550 volts, at which pressure the current is used throughout the mill.

The company's transformer station will contain three banks of three 75 kv.a. single phase transformers, giving something over 1,000 h. p. available for use of the different plants.

All of the gypsum will be thoroughly dried, before grinding, in a large rotary dryer. The drying of the rock will facilitate grinding and pulverizing.

The pulverizing is done on a new type of roller mill in place in the old fashioned buhr stones which have so



View of the New Fireproof Mill of the Crown Gypsum Co., Ltd. The pulverizing is done by a new type of roller mill, manufactured by Raymond Bros. Impact Pulverizer Co., Chicago, Ill., in place of the old fashioned buhr stones which have so long been regarded by gypsum manufacturers as a necessary evil.

long been regarded by gypsum manufacturers as a necessary evil. Raymond Bros. Impact Pulverizer Co., Chicago, Ill., furnish the pulverizing and air separating machinery in this plant. Air separation in connection with the pulverizers insures material of a fineness which will permit from 94 to 96 per cent to

Forty-foot Rotary Drier on Car Before Unloading. All machinery in this Gypsum Mill is electrically driven by individual Westinghouse motors.

pass a 100 mesh sieve and at least 75 per cent through a 200 mesh standard testing sieve. It is recognized a better plaster will carry a greater proportion of sand and make a denser wall, but that it will not age to any perceptible extent.

The calcining will be done in three or more kettles of special design, with temperature control by individual thermometers assuring uniformity of material at all times.

All mixing and packing will be done in a separate building removed some distance from the main mill building. This building is of heavy mill type con-

struction, having cribbed bins for the storage of material. All ingredients going into the mixed goods will be weighed carefully in a hopper scale suspended over the mixer. Sacking will be done by the Bates process of valve-bagging machines by which the packages are filled and weighed and delivered into the car by a conveyor at the rate of about thirty tons an hour. Excellent facilities for car handling and the storage of loaded and empty cars are afforded by private tracks from the Michigan Central railroad on each side of the mill.

The company owns an unlimited supply of what is claimed to be the finest gypsum rock in Canada. This together with the mill facilities will produce a very high grade material.

All business will be transacted from Lythmore, where both the general office and mill are located.

The directors of the company are as follows: Messrs. Whitney G. Case, H. J. Brown, Chester W. Fell, Frank B. Hower, and Edward W. Case.

The officers are as follows: President, Mr. Whitney G. Case; Vice-President and Secretary, Mr. H. J. Brown; Treasurer, Mr. Edward W. Case.

The Sales Department will be in charge of Mr. C. E. Williams, whose extended connection with the business is an eminent qualification for the duties of the position. Mr. Williams was identified with the United States Gypsum Company for seven years, first as auditor and later as assistant to the General Sales Manager.

OIL MIXED CONCRETE.

A bulletin of the Department of Agriculture, Office of Public Roads, has recently been issued which describes investigations of the effect of mixing oil with concrete.

While experimenting in the Office of Public Roads in an attempt to develop a nonabsorbent, resilient, and dustless road material, one capable of withstanding the severe shearing and raveling action of automobile traffic, the writer's investigations led him into a very promising discovery. He found that, when a heavy mineral residual oil was mixed with Portland cement paste, it entirely disappeared in the mixture, and, furthermore, did not separate from the other ingredients after the cement had become hard. The possibilities of oil-cement mixtures for waterproofing purposes were recognized and extensive laboratory tests were immediately begun to determine the physical properties of concrete and mortar containing various quantities of oil admixtures.

Many valuable data have been obtained from these investigations. The damp-proofing properties of concrete mixtures containing oil have been demonstrated very definitely by laboratory and by service tests which establish this material as one of great merit for certain types of concrete construction. It has also been shown that the admixture of oil is not detrimental to the tensile strength of mortar composed of 1 part of cement and 3 parts of sand when the oil added does not exceed 10 per cent of the weight of the cement used. The compressive strength of mortar and of concrete suffers slightly with the addition of oil, although when 10 per cent of oil is added the decrease in strength is not serious. Concrete mixed with oil requires a period of time about 50 per cent longer to set hard than does plain concrete, but the increase in strength is nearly as rapid in the oil-mixed material as in the plain concrete. Concrete and mortar containing oil admixtures are almost perfectly nonabsorbent of water, and so they are excellent materials to use in damp-proof construction. Under pressure, oil-mixed mortar is very efficient in resisting the permeation of water. Laboratory tests show that oil-mixed concrete is just as tough and stiff as plain concrete, and, furthermore, its elastic behavior within working limits of stress is identical with that of plain concrete. The bond or grip of oil concrete to steel reinforcement is much decreased when plain bars are used. Deformed bars, however, and wire mesh or expanded metal will reinforce this material with practically the same efficiency as in ordinary concrete.

A very interesting experiment showing the nonabsorbent and nonpermeable character of oil-mixed mortar when subjected to low pressure was made in the laboratory. Four mortar vessels, 8 inches in outside diameter, 2½ inches high, and about ½ inch thick, after hardening in moist air for one week, were immersed in water to a depth of about 2 inches. A mortar mixture of 1 part of cement to 3 parts of sand was used. Vessel No. 1 contained no oil in the mixture. About one minute after immersion a damp spot showed on the bottom. After one hour the whole vessel was wet even above the water level, since the water had climbed by capillarity. Within a few days water had penetrated the plain mortar vessel until the water level inside was the same as that outside. The remaining three vessels, made of 1:3 mortar and mixed with 5, 10, and 20 per cent of oil, respectively, have remained perfectly dry on the inside during immersion for one year.

All of these experiments have given very encouraging results and point to the use of oil-mixed mortars and concretes as a cheap and effective solution of the problem of waterproofing for a great many types of concrete construction.

All of the laboratory and service tests thus far made on oil-mixed mortars and concretes are indicative of a wide future usefulness for these materials, principally in damp-proof construction. There are many types of structures through which the permeation of moisture is ruinous to either the appearance or the efficiency of the construction, or is seriously detrimental to the health of either animal or human life. The efflorescence due to the leaching out and subsequent carbonization of the lime on the surface of a concrete wall might well be prevented by the incorporation of an agent capable of excluding all moisture. Again, the dampness of many cellars, with its danger to health could have been prevented had the walls and floors been damp-proofed. The following types of structures might be damp-proofed at an exceedingly slight extra expense by the incorporation of a small amount of the proper kind of mineral oil residuum with the mortar or concrete used in construction: Basement floors, basement walls, watering troughs, cisterns, barns, silos, concrete blocks, roofs, stucco, and numerous important engineering constructions.

The Illinois Central Railroad has built a switch to the plant of the Blood Sand and Gravel Company, of Grayville, Illinois, to facilitate growing business of that company. The Blood company on August 1 raised its price for sand delivered to $1.00 a yard, gravel delivered $1.25 a yard and 25 cents a yard less on the bank.

Jackson & Church have purchased the business, consisting of rights, patents, good will, etc., of the American Sandstone Brick Machinery Company, of Saginaw, Mich.

Some Thoughts on the Development of the Sand Lime Brick Industry

By P. L. Simpson of the American Clay Machinery Co., Chicago, Ill.

Paper read before the Sand Lime Brick Manufacturers' Association at their Convention at Toronto, Canada; December 3. 1912.

Thirty-two years ago a patent was granted in Germany to Dr. Wm. Michaelis, which patent covered the following claim: "The hardening process and the combination of all modifications and all compounds of silica and calcium hydroxide at temperatures above 100 degrees Cent. in the presence of saturated steam, that is to say, high pressure." Thus in 1880, the discovery of the hardening process for sand-lime brick, by high pressure steam, was made, and like other inventions it was suggested by antecedent processes and especially what was known as the Frederick Ransome process. It seems that Dr. Michaelis had great respect for the Ransome process and endeavored to collaborate with Mr. Ransome of England to make a commercial success of the product. But in this respect they were doomed to disappointment, although

Fig. 1. Natural Sand Grains, Enlarged 40 Diameters.

the product in itself was ideal and the ordinary sand-lime brick as produced today would not compare with it.

Briefly the Ransome process of manufacturing artificial sand stone, according to Dr. Michaelis' work on the "Hardening of cement under water," translated by his son, Dr. Wm. Michaelis, Jr., is as follows: "Ninety parts by weight of pure quartz sand, consisting of grains of various sizes are mixed with concentrated sodium water glass in such quantities that five parts by weight of soluble silica are contained in it; this mass is molded and then immersed in a correspondingly strong solution of calcium chloride, in which it hardens by the formation of colloidal calcium hydro-silicate, originating from the reaction between sodium silicate and calcium chloride, the sodium chloride likewise resulting from this reaction being washed out by running water and the artificial stone is dried in the air." This process yields an artificial sandstone of a compression strength of from 7,000 pounds to 12,000 pounds per square inch.

The process, you will note, was ideal in quality, but unfortunately commercially unprofitable and therefore the scientific mind of Dr. Michaelis looked about for a solution to the problem how to manufacture artificial sandstone that would compete in the market, both commercially and from the standpoint of quality, and so the process was evolved for the manufacture of sand-lime brick as we know it today.

Notwithstanding that a patent was granted to Dr. Michaelis in 1880, yet other patents were granted for the use of mixtures of various kinds, all of them infringing on the basic patent of Michaelis, and he could not understand how these subsequent patentees were able to obtain patents at all in the face of his original patent and invention. Dr. Michaelis at that time did not foresee what a great industry his discovery would

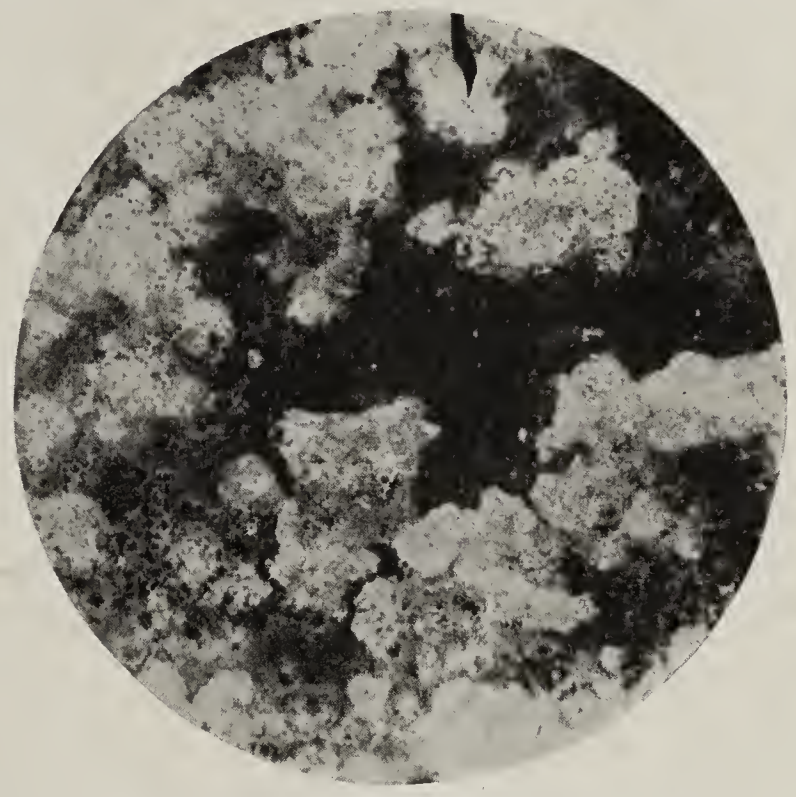


Fig. 2. Sand Grains Ground for Five Minutes in a Wet Condtion, Enlarged 40 Diameters.

lead to, in fact he was anything but an optimist regarding the success of the process commercially, and he did not anticipate that sand-lime brick could compete with clay brick. Doubtless he had in mind the magnificent specimens of artificial sandstone that he had produced by the Ransome process, with its crushing strength of from 7,000 to 12,000 pounds per square inch. His ideals were too high for commercial purposes, and for that reason he was deeply disappointed with the outcome of his endeavors. Such is the experience of most inventors. He was not of the class to which Graham Bell or the Wright brothers belong, a good financier as well as a great inventor. The mind of the average inventor is concentrated upon the creating of a new thing to the exclusion of the mere idea of making money out of it.

Two great modes of thought divide the world, the real or practical, and the ideal or visionary. To the former belongs the cold, calculating business man who looks upon every problem from the standpoint of finan-

cial gain, while the latter focuses his mind on the creation of something new, oftentimes regardless of pecuniary benefit. But it is the dreamers like James Watt, Marconi, Graham Bell or Dr. Michaelis who have revolutionized the world and made modern civilization what it is today.

And now consider the important point I have been leading up to, viz., that it is our duty in manufacturing sand-lime brick to combine the ideal in respect to quality with the practical and commercial.

I have spoken of the patents that were granted to auxiliary processes, all of them using the basic idea of the original discoverer, Dr. Michaelis, among them I may mention the hydrochloric acid process of Kleber, the caustic soda process of Prior transferred to Hueneckes, and the process of Schwarz, where the lime is slacked in combination with the sand in so-called "vacuo." All these latter processes have been discarded as being complicated and having no superiority over the methods originated by the inventor.

But like other inventions or discoveries, the beginning is generally complicated and as the industry grows a process of development leads to the erection of sand-lime plants with an eye single to the principle of simplicity, consistent with labor-saving and automatic methods.

The all-important question with us now is whether a calm review of the present status of the industry would lead us to believe that we have reached the *ne plus ultra*, and whether the manufacturers of sand-lime brick are standpatters or progressives. I trust that we may be infused with the spirit of progress that recently has had significant expression from the voters of this country in matters political, so that our minds may be ever on the alert for ideas looking to the betterment of our product, never forgetting the equally important parallel ideas of the practical and commercial.

That we have made good progress in our methods of manufacture is undoubtedly true, but the proper spirit is never to rest content with what we have, but to look forward to still greater improvement in the future.

In discussing some of the essential conditions necessary for a successful sand-lime brick plant, I may name the following:

The quantity and quality of the sand. In regard to the quantity this is easy to determine by an investigation of the supply and the probable market. This part of the business generally receives proper attention, but the all-important question of the quality of the sand is too often neglected.

You will note that Dr. Michaelis in his experience with the Ransome process speaks of using sand "consisting of grains of various sizes." This feature is of great importance, as the voids or interstitial spaces separating the largest grains must be filled by the grains next in size, and so on to the smallest size of grain, the ratio of size varying in some instances from grains of 30 to 40 mesh, to the almost dust condition of grains as fine as from 100 to 150 mesh. The chemical condition of the sand is of course important, inasmuch as it should be clean and pure, because all the constituent parts other than the silica tend to hinder or retard the reaction with the lime in the hardening process. But the physical condition is of equal importance, inasmuch as it is principally the fine sand over the size of 100 mesh that constitutes the binding agency, and it is this aspect of the subject that has suggested the use of the wet and dry grinding mill, and which has been the means of improving the quality of sand-lime brick to a wonderful degree.

It is difficult to fully account for the great increase in the average quality of sand-lime products by the introduction of this machine, because even when the sand is not long enough in the pan to materially grind a very appreciable quanity of it to fineness, yet the mulling itself seems to be of great benefit to the mixture. There cannot be any doubt, however, that the treatment of the sand, especiallly when in a wet condition increases the plasticity of the mixture and which may be accounted for by the partial pressing of one

Fig. 3.

particle against another, thus pressing out as it were the atmospheric air from the spaces, rendering the mass easier of being pressed into brick, the particles thus getting a much stronger hold one on another. A partial grinding even with a sand ideal in respect to variable size of grain is certainly of great value in improving the value of the product and which may be due in part to the resulting colloidal condition of the mass.

Cushman in his pamphlet entitled "The effect of water on Rock Products," issued by the Department of Agriculture as Bulletin No. 92, states as his conclusion that "The effect of wet grinding is to increase the binding power or cementing value of rock products and that the formation of colloids upon the surfaces of the particles would account for the increased binding power under the action of wet grinding." Cushman gives quite a number of micro-photographs which clearly show the improvement of the mass due to wet grinding.

The sand lime industry has been wonderfully improved by the introduction of the wet pan. In this country we expect the machine to do some grinding as well as mulling and mixing, whereas in Europe at least in most of the plants that I had the pleasure of visiting the latter function, viz., that of mulling and mixing was all that was expected of the machine.

In several works in Germany that I visited one 9′ pan was used for two presses, each press turning

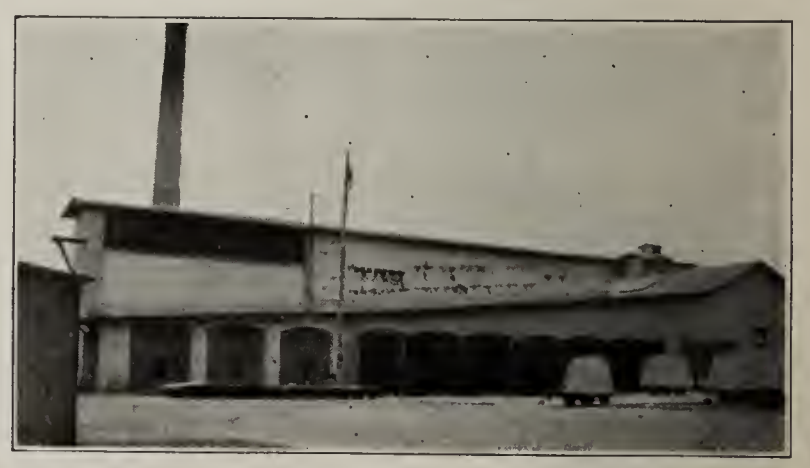


Fig. 4

out 25 thousand brick per day, while in one of the works in Scotland the mixture was put through a dry pan after coming out of the quota of water when being mulled in another pan, where it was finally prepared for the press, and this thorough preparation was used for the comparatively small production of about 17 thousand brick 9″x4½″x3″, the product being superior in every way, although such preparation probably would have been improved had the grinding and mixing been confined to one machine and instead of first mixing and grinding the material in the comparatively dry condition it is in as it comes from the silo, it had been ground wet, the plasticity would have doubtless been greatly improved.

Cushman conducted an important series of experiments to show the relative difference between dry and wet grinding. In one experiment with sandstone the cementing value was increased from 25 to 78, in another 61 to 174, and still another from 12 to 34. The same investigator ascribes this wonderful result to the formation of colloid films on the surfaces of the particle.

Since the time in the first half of the last century, when a distinguished authority on molecular physics, Graham of Glasgow, used the expression "colloids," there has been a serious difference of opinion regarding the meaning of the word, some ascribing the phenomena to chemical action, while others to physical transformation, one authority asserting that colloidal action on rock products was simply due to the very fine grinding of the particles, the increase of such effect being largely augmented when finely ground in a wet condition.

Figures 1 and 2 are two micro photographs taken in the laboratory of the American Clay Machinery Co. by Mr. Hollis B. Crum. Fig. 1 shows the sand particles in their natural condition, while Fig. 2 shows the same ground in an agate mortar for five minutes in conjunction with water, both enlarged 40 diameters. You will note the definite change in the structure of the sand; in fact, its crystalline condition is transformed into a highly plastic condition and it is easily seen from an examination of these micro photographs why it is that the grinding and mulling of the sand vastly increases the cementing value of the mass.

Be that as it may, our aim is to apply this important principle of increased plasticity due to wet grinding to the every day practical methods in manufacturing sand lime brick. It would appear, therefore, that when the sand is dry, either in the banks in the summer season when using the prehydrate system, or when coming out of the silo in the latter system, then instead of waiting until all of the sand is in the pan, there should only be a small proportion introduced at first and that portion should receive **all the water** that may be required for the ultimate batch, thus taking advantage of the researches of such authorities as I have named.

It is somewhat remarkable that the use of the wet pan has been so long in being adopted in the manufacture of sand-lime brick. Dr. Michaelis anticipated its use as far back as 40 years ago, when he states that in making artificial stone by the Ransome process the mixing of the silicate water glass and sand is done "very carefully and thoroughly" by means of edge runners, the latter being another type of the wet pan.

It has also been found by experience that the mixture prepared for the brick machine should be as wet as it is possible to be fed into the molds, which is also an important principle in the production of clay brick.

And now we come to a discussion of the various processes for the slacking of the lime and its incorporation with the sand, especially those that have been adopted in modern practice.

My observations during a visit made to Europe last year convinced me that no modern plants were installing any form of pre-hydate systems. Sand-lime engineers, especially in Germany, had reduced their practice to two systems.

First: The Loesch-Trommel or hot silo slacking drum system, and Second: The Regular Silo System.

In the first named, the process is substantially as follows: The slacking drum is a cylinder about 20 ft. long by 5 ft. at its widest diameter. It is strongly built with sufficient strength to withstand a pressure of at least 150 pounds per square inch.

Some of them are provided with two openings but most of them are furnished with only one, located midway between the two ends and furnished with a heavy lid which is arranged so that it can be taken off and screwed on again with the greatest facility possible. It is provided with a steam gauge and safety valve, latter set to blow off at 60 lbs. pressure. A charge or batch is four cars of sand, each car containing about one cubic yard and first of all two cars are emptied into the cylinder by means of a funnel shaped hopper, the top of which is level with the track floor upon which the sand cars run. Then a car containing the proper quantity of lime for the entire batch of four cars of sand is dumped in and the lid securely fastened on; then the cylinder revolves, the speed being about 3 to 5 revolutions per minute. This goes on for a few minutes so as to insure a partial mixing of the lime particles through the sand, then a given amount of water is allowed to run into the cylinder, the latter all the time revolving. Very soon the slacking of the lime begins and the steam arising from the reaction begins to show on the steam pressure gauge, which is closely watched. In case the steam gauge should fail to blow off at 60, the pressure in that event is released by the opening of a valve, connecting with a pipe leading to the outside of the factory. Should there be a deficiency of steam pressure from the reaction of the lime with the water, then live steam at 60 lb. pressure to the square inch is let into the cylinder. After a certain time the live steam is turned off and the cylinder kept revolving about ten minutes from the time of starting. An examination of the steam gauge during that time shows a gradual decrease in steam pressure after the live steam is shut off, this being due to the chemical absorption of the water or steam vapor with the lime. You will note that the slacking of the lime is taking place while it is being mixed with the sand and when about ten minutes has elapsed the lid of the cylinder is removed and the remaining two cars of sand containing one cubic yard each are dumped into the cylinder and again revolved about 30 minutes, or until the whole is thoroughly mixed, when the contents are dumped into a bin or small silo. The whole operation of preparing over four cubic yards of material, or enough for 2,500 brick occupying about one hour's time. Of course the mixture is at this time in a hot condition, but the bin or silo is large enough so that before the mixture reaches the press it is sufficiently cooled off for the bricks to be handled without difficulty by the off-bearers.

The material is taken out of the silo or bin by automatic methods and elevated up into a wet pan where the mixture receives its additional amount of water to render it suitable for pressing.

The caustic lime is prepared by passing it through a

rock crusher to break up the lumps, then elevated from same to a ball mill and from there elevated to a sheet steel bin provided with slides at the bottom and from which the cars are charged to be emptied into the slacking drum. The lime was not finely pulverized, although it was admitted that finer particles would have been beneficial. The wet pan was provided with quite wide muller and no attempt was made to do any grinding with it; in fact, but one pan was used for the production of two presses, therefore all that was expected of the pans was the kneeding or mulling of the mixture from the silo.

In regard to the labor necessary to operate this system, two men were sufficient to operate two slacking drums, the charging of one being accomplished while the other drum was slacking and mixing a batch. One man operated the pan which as I have said did the

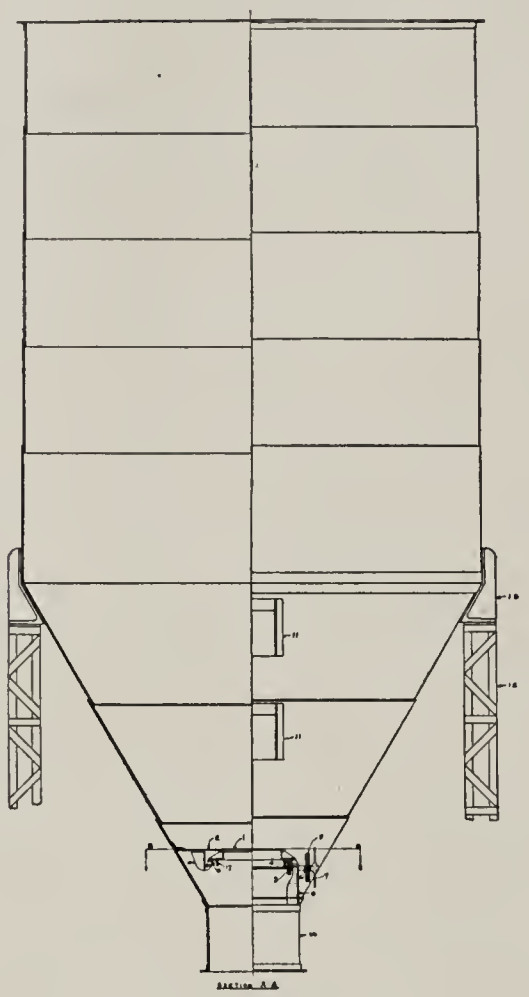


Fig. 5. Round Steel Silo.

work for two presses. No attendants whatever were used between the operators at the slacking drum and the wet pan, the operations being automatic. One man attends to all the lime for the entire production of six presses, which at 25,000 for each would total 150,000 of German brick, size 125 mm. x 60 mm. x 25 mm.

You will therefore note that for a unit of two machines the following are the men required: Two men at the slacking drums, one man at the wet pan and six off-bearers for two presses, or nine men for 56,000 brick per day, this being exclusive of the men required for loading up the cars with sand at the bank, attending to the cylinders, unloading the caustic lime from the cars and loading the brick for shipment, besides one-third of the man's time for granulating the lime when all six presses are running.

Figure three (3) shows the rear view of a plant operated as described.

Figure four (4) is the front view. One special characteristic of the plant being the almost total absence of dust.

As you may be aware, an attempt was made to introduce the hot silo slacking drum process at Kalamazoo, Mich., but it appears it was not a success for reasons unknown to the writer, not knowing all the conditions incident thereto. The process is certainly a success in Germany, and it is difficult to understand if conditions are the same why it could not be made a success in this country.

Regular Silo Process. The prevailing sentiment amongst the sand lime engineers in the mother land of sand lime brick is perhaps in favor of the straight silo process, although there is quite a strong advocacy of the Loesch-Trommel or hot silo process as above described. All other processes, especially any form of prehydrate system being practically eliminated from serious consideration.

The largest sand lime brick plant in the world having a capacity of 440,000 brick per day of 24 hours. The Berliner Kalksandsteinwerke (Robert Guthmann), Berlin, works at Niederlehme, and with an investment of four million marks (one million dollars), use the straight silo process. You are all more or less familiar with this process and so I will discuss it quite briefly and will only endeavor to point out the difference in the practice here with that in modern plants in Europe.

The preparation of the lime is similar to that described in connection with the hot silo or slacking drum process, viz., by the rock crusher and ball mill. In the plants I was privileged to inspect in Germany the caustic lime was granulated and not pulverized, the granules being as large as from 1/8 in. to 3/16 in. in size. It was admitted by some of the managers of these plants that such practice was a mistake and that the latest and best installations used a system of separation that resulted in reducing the caustic lime to a fine dust which is decidedly the proper condition for the caustic lime to be in for the silo process. In one works I visited, that of Robt. Brand & Son of Perth, Scotland, the caustic lime was reduced to a powder of about 100 mesh fineness, and this condition of the lime in that case, together with proper mixing and mulling of the material after it was taken from the silo, produced a brick unequaled by any that it was the writer's privilege to examine.

The preparation of the lime is usually performed in a separate building from the main machine room, so that the dust nuisance may be eliminated. The caustic lime powder being conducted over to where it can be automatically measured and conjoined to the sand. The latter is also automatically measured and in such a way that the arrangements for the feed may be varied accordingly as the sand is dry or wet in the sand bank. An ordinary pug mill mixer is then used to mix the two materials together. The pug mill being of such a length as to admit a sufficient mixing before the water is applied that is required for the hydrating of the lime in the silo. The installation of two separate pug mills for this purpose is even a better arrangement as both the mixing of the sand and lime and the wetting of the mixture is more thoroughly accomplished. An alternative process which has some advantages over the system described is to use a small dump car containing about half a cubic yard of sand and the proper proportion of lime; this is hoisted up to a batch mixer situated above the silo, and it is then mixed and the necessary amount of water added to the mixture, which may be varied according to the condition of the sand then the whole contents are emptied into the silo. It is oftentimes easier to elevate the sand and lime to the mixer, the latter being over the silos, than it is to elevate the mixture in its wet condition, as the material is apt to adhere to the elevator buckets and require constant cleaning to prevent its hardening on same.

In regard to the kind of silo that is best to install, there is a wide difference between American and German practice. In the former they are almost invariably made of wood and requiring expensive conveyors both above the silo to distribute the material into the same and also similar arrangements underneath for conveying the siloed material to the wet pans for further preparation.

In Germany, on the other hand, in modern plants the siloes are invariably of steel, generally about 25 to 30 feet high and from 8 to 15 feet in diameter. Figure five (5) is a sketch of such a silo.

In comparatively small plants these are divided into three divisions, each containing enough material for a day's run on one machine of, say, 22,000 to 25,000 brick. This arrangement has the advantage of allowing the lime to complete its hydration for a period of 48 hours instead of 24 hours, as is the case when the silo is divided in two. Near the extreme bottom of steel silo is a floor in which is located a gate or slide for each division of the silo. These gates are operated by a double rack and pinion and two star or handwheels so that they may be moved as far out or in as may be necessary. At the extreme bottom of the silo is an automatic emptier which supplies a regular feed to the wet pan. The entire structure is resting on four or six heavy iron posts.

You will note the substantial nature of the structure and how much better it is both for filling and emptying than the wooden style of silo common to this country.

The location and arrangement of the wet pan vary according to conditions, sometimes it is located low enough so as to admit of the material from the automatic feeder below the silo emptying directly into it, the feeder stopping and starting as may be necessary for the proper grinding, mixing and mulling of the mixture. In this case, of course, an elevator is necessary to elevate the prepared material over the presses. This arrangement can only be accomplished in cases where proper drainage makes it possible.

When the wet pan is located on the level of the floor, then of course a short elevator is necessary to elevate the siloed material to a reservoir or bin over the wet pan to be drawn upon as required.

In the silo process you will also note that the extensive use of automatic feeders is possible and therefore the labor required is reduced also to a minimum. One man at the preliminary mixer and one man at each of the two wet pans is all that is required for a two-press plant of 45,000 to 50,000 per day. The offbearers, the men bringing in the sand, the pulverization of the lime, etc., etc., being the same as for the hot silo process first discussed.

Of all the processes so far developed considering the subject from both its practical and scientific aspects the straight silo system when properly installed according to the latest ideas and when properly managed is undoubtedly the most up to date process that exists today. It is true, of course, that it requires a lime high in calcium content and there cannot be magnesia in its composition greater than from 3 per cent to 4 per cent. The less magnesia there is in the lime, the better it is for the silo process, but as a matter of fact it is necessary for all processes to have a lime high in calcium, regardless as to the method of hydration adopted. I have yet to know of a successful plan even when steam hydration is used that uses a dolomitic lime; therefore, admitting this to be the fact, it is well to adopt a process that combines to the greatest extent the economic or practical with the scientific.

The preference shown by the writer for the silo system in this paper is based on a number of fundamental considerations.

I have spoken of the importance of the caustic lime in the silo system being fully ground and properly mixed before being deposited in the silo, and it is therefore pertinent to compare the physical condition of the mixture at this stage with a mixture of sand and lime prehydrated. In the case of the silo system, fine grains of caustic lime adhere to the sand particles and are also in contact with the water contained in the sand; then when chemical action begins these minute grains of caustic lime swell and burst to two or three times their original bulk. It is, therefore, reasonable to observe that if there are any spaces between the sand grains or any particles of sand not coated with the lime, the swelling and bursting of the caustic lime incident to chemical action will disseminate and squeeze into these spaces and thus create an additional cementing agency for the sand particles. No such phenomenon as this is involved in the prehydrate system and therefore any particles in that system are naturally left without adhesive support when sand grains exist that may not have received its quota of lime. There is no further help for it, but in the case where caustic lime is mixed with the sand there is an additional chance of obtaining a more perfect mixture by taking advantage of the natural reaction effected by the swelling and bursting of the lime grains when in the process of hydration throughout the sand mass.

Another important point is this: The heat generated in the hydration of the lime is entirely lost when the prehydrate system is used, whereas the heat generated in the silo due to the hydration or the lime in the sand increases the colloidal condition of the sand particles and which condition is not destroyed in the subsequent cooling of the mixture. It would seem that this is one of the strongest arguments in favor of the silo system.

Another point in favor of the caustic lime silo process and against the prehydrate system is the impossibility of automatically proportioning and feeding hydrate of lime. Attempts have been made to devise apparatus by which this could be accomplished, but all to no purpose.

In this country a prehydrate system is now in use in some plants and which was developed by the genial and energetic secretary of this association and which is a modification of what was known at one time as the Dodge system of hydration, whereby the lump caustic lime is hydrated by water and emptied into close concrete or brick bins where it is allowed to lie until it is fully hydrated. This process has the advantage of simplicity and comparatively low first cost, but in all its essential aspects it is unscientific and not in accord with the best practice where research into the fundamental principles of the business has received its greatest impulse.

Such a process is not possible without the wet pan, and even then it is difficult to believe that the conditions which secure the highest cementing value can be compared to the silo systems herein discussed.

The principle that should actuate us in this business is not only to choose rightly as between existing processes, but to develop still better methods, always endeavoring to combine the scientific and theoretical with the practical and continually strive after the perfection which was the guiding star in the life of the great founder of the sand-lime brick industry, Dr. William Michaelis, Sr.

Medusa White Portland Cement

For Ornamental Work

Portland cement has proved superior to all other building materials in strength, convenience, durability and cheapness, and has practically supplanted them in all heavy construction, but its unattractive color has prevented its use in the higher class of ornamental work.

Gypsum plaster in various forms, such as Keene's cement, has been largely used for interior work, but has proven unsatisfactory for out-door use through its inability to stand exposure to weather. Certain slag cements, and the "grappier" cement, made by grinding the residue of hydraulic lime manufacture, are nearly white in color, and have been considerably used in Europe, but are so far inferior to Portland cement, in strength and hardness, as to have given little satisfaction.

Experiments made by S. B. Newberry, vice-president and general manager of Sandusky Portland Cement Company, Sandusky, Ohio, have finally produced MEDUSA WHITE PORTLAND CEMENT of pure white color, and equal in strength and other qualities to the best gray Portland cement. This company has built a special factory for the manufacture of this product, and for the past four years has been shipping it in large quantities, to the universal satisfaction of customers.

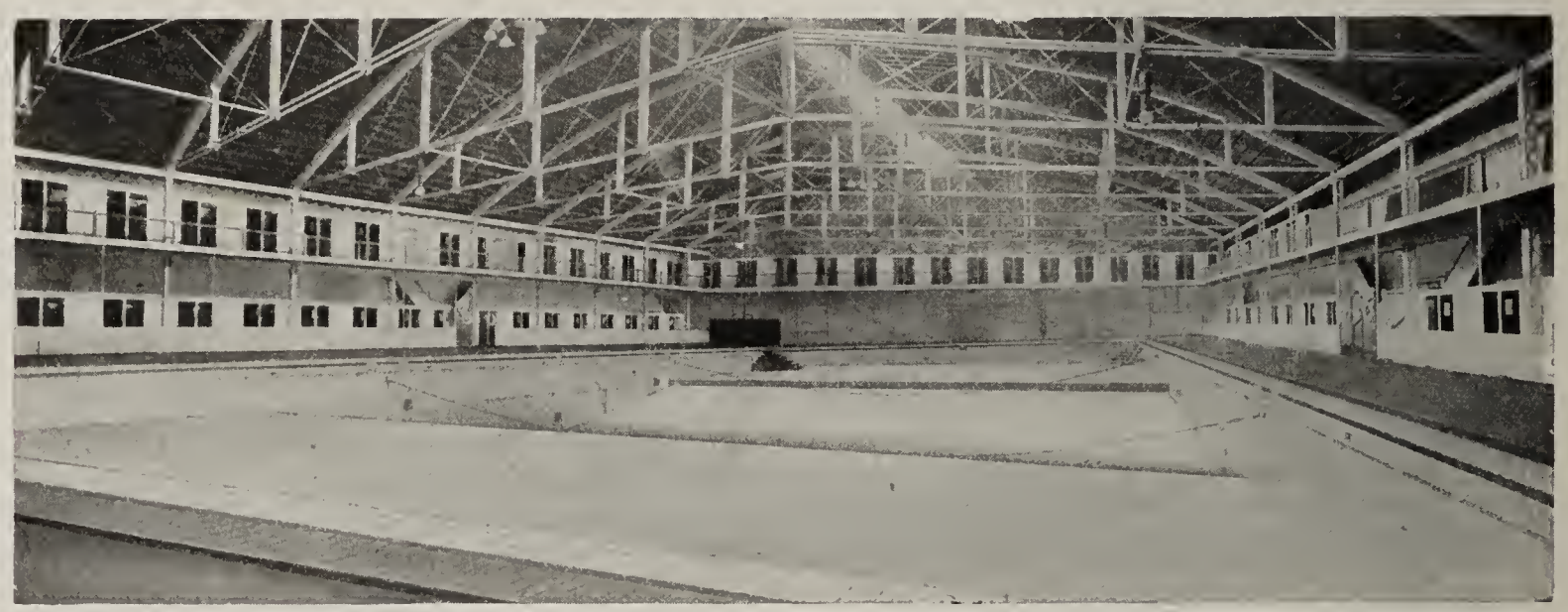
Medusa white cement is guaranteed to be a high testing Portland, passing standard specifications, and is the first true white Portland ever manufactured. It is shipped in duck sacks, returnable, or in paper lined wooden barrels, of standard size for ordinary Portland cement.

coating, reliefs and stair-cases can be obtained by the use of Medusa white, while its use with white crushed marble for monuments, vaults, columns, urns, and plot borders in cemetery work, after washing off the finished product with dilute muriatic acid produces a sparkling effect rivaling that of the best white marble. It is unexcelled for fountains, seats, railings, walks and gate-ways for parks and grounds.

The exterior of the rough walls of the California State Normal School, San Jose, Cal., are covered with a pebble dash of Medusa white Portland cement. This work was completed about a year ago and is said to be the largest re-inforced concrete school building, in ground area, in the world. Because of its immense proportions and unusual exterior treatment it is attracting world-wide attention.

Over 5,000 barrels of Medusa waterproofed white Portland cement are now being used in the Woolworth building, New York City, the highest office building in the world, while the United States Government has used Medusa in the Senate office building, National museum, New York City post office and many other post offices and buildings. This product was also used in the ornamental concrete work on stadium of Polo grounds of New York National League Baseball Club, and in the construction of H. R. H., the Prince of Wales' racquet court, Marlboro house, England.

Free samples and booklets illustrating and describing some of the work in which Medusa white Portland cement was used, and containing tests and testimonials, will gladly be furnished on request.



Auditorium—Natatorium, St. Louis, Mo. Largest in the United States. Waterproofed with Medusa Waterproofing.

Medusa white Portland cement will be found suitable for building ornamentation such as steps, columns, doorways, window casings, cornices, panels and for stucco, statuary, tile, mosaic, stainless mortar for laying up Bedford limestone, sandstone or marble. For concrete building blocks Medusa white Portland can be used in conjunction with Medusa waterproofing for facing or entire body of absolutely damp-proof hollow concrete blocks, of pure white color or any desired tint. White limestone or crushed white marble and Medusa white Portland cement produces effects which give the appearance of solid blocks of white marble, and if the surface is washed with dilute muriatic acid and then scrubbed with water, a texture is produced which rivals natural stone. Pure white floors, wains-

MEDUSA WATERPROOFING.

The Sandusky Portland Cement Co. is also a manufacturer of Medusa Waterproofing, a dry white powder consisting of fatty acids chemically combined with white lime, which is mixed dry with dry cement before sand and water are added, thus becoming an inseparable part of the concrete. Qwing to the extreme fineness it may easily be perfectly mixed with cement in the necessary proportions.

Medusa Waterproofing does not affect the color, strength, setting or hardening qualities of concrete, and when used in proper proportions it will make any concrete work impervious to water and prevent discoloration from rain. It also prevents the white efflorescence which so often renders cement work un-

sightly, and prevents the appearance of hair cracks on the surface.

Medusa Waterproofing is specified by the most eminent architects and engineers in the United States and Europe, and is rapidly displacing the old-time paints and coatings formerly used to prevent the penetration of water into concrete.

It will be found to be especially useful in making building blocks, cement plaster, roofing tile, cellar walls, cistern and reservoir linings, conduits, sewer pipe, elevator pits, and in a multitude of other uses in which resistance to percolation of water is required.

100,000 pounds are now being used in the New York Dock Co. job, Atlantic Basin, Brooklyn, while the United States Government has used Medusa in work at Puget Sound Navy Yard, Fort Monroe, Va., and other points.

Samples and free illustrated booklets describing some of the wonderful results obtained with Medusa will be sent to those interested.

Gray and white waterproofed Portland cements are also manufactured by the Sandusky Portland Cement Co. and consist of Medusa waterproofing ground with Portland cement in the process of manufacture and is a most valuable addition to the list of high-class building materials. This company is the exclusive manufacturer of both cement and waterproofing, and as the demand for this new product has far exceeded expectations, it has been found necessary to install extra grinding machinery and packing apparatus to enable them to fill orders promptly.

A MODEL REINFORCED CONCRETE FOUR-STORY MACHINE SHOP.

There has recently been completed at Lowell, Mass., a four-story machine shop built of reinforced concrete with brick curtain walls to be used by the Lamson Consolidated Store Service Co. for manufacturing conveyors, pneumatic tubes, carrier systems, etc. The entire contract was executed by the Aberthaw Construction Co. of Boston, in accordance with plans and specifications prepared by the architects and engineers, Lockwood, Greene & Co., also of Boston.

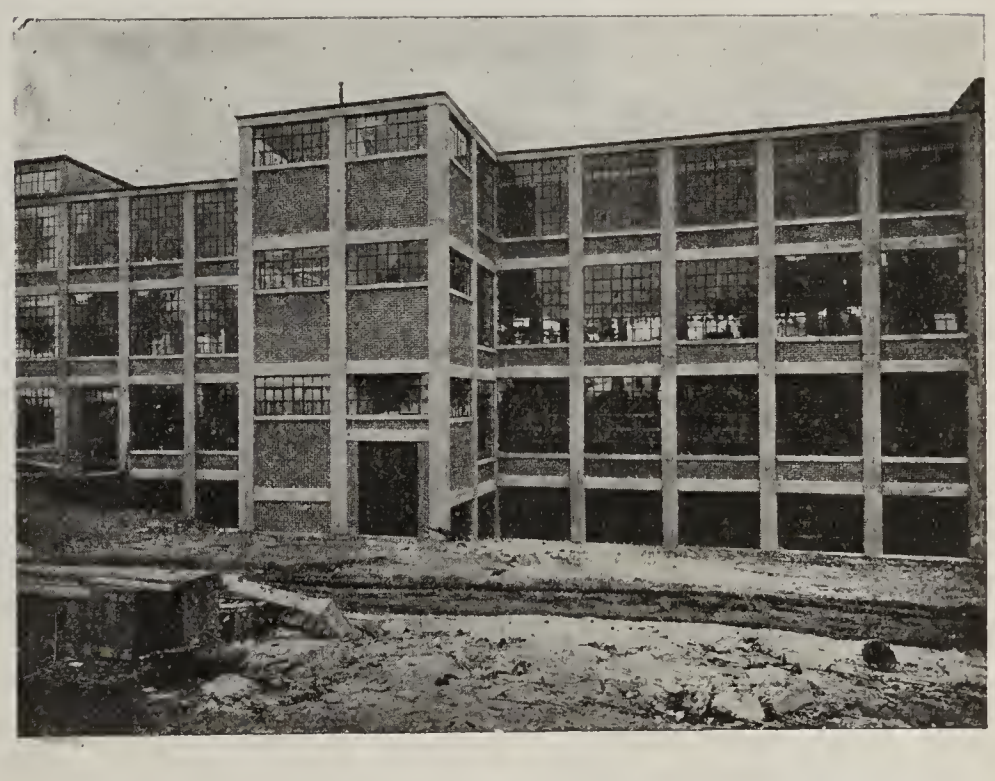
The exterior of the building is particularly pleasing and is a good example of the excellence of using brick curtain walls in concrete buildings of this type. The building adjoins a plain brick structure and there was a question in the owners' minds as to whether this addition would harmonize with the old plant. The recommendation of the architects for using the construction adopted has more than proven their excellent judgment, as the old and new structures harmonize quite well.

This machine shop is 150 by 50 feet in plan, with four stories. Steel sash has been used throughout. Extending down the center of the building on all the floors is a single row of columns spaced 10 feet on centers. The beam and girder type of construction is used. The first and second floors were designed for live loads of 250 lbs. per square foot, while the other floors were figured for 150 lbs. The height from finished floor to finished floor is 12 ft. 4 ins.

A particular feature of the interior construction is the method of attaching the shaft hangers. In place of the ordinary inserts, grooves were cast in the sides of the beams and the hangers clamped to the beams. This construction is absolutely flexible; the hanger can be attached at any desired point along the beam and may be shifted at will to another point, or to any other point should the location of the machinery be altered.

Although this building is a comparatively small structure and the design was as regular as possible, 113 different kinds of forms were required, making a total of about 600 forms in all, using in the neighborhood of 10,000 square feet of stock. In order to reduce the cost of these forms to a minimum the Aberthaw Construction Co. made detailed drawings of the same in their drafting room, as it is their policy to pay thinking men to think, and carpenters to saw boards.

It is interesting to note that this structure was erected in part during the severely cold weather of last winter. The Aberthaw Construction Co., as is usual in their winter work, took great precautions to insure the setting of the concrete before freezing. The aggregates were heated by steam pipes, and not only was the water warmed by steam pipe but salt was added, generally in the proportion of about 2 per cent of weight to the amount of cement used, the percentage being varied slightly as the temperature changed. The method of applying the salt was to make a saturated solution in a separate barrel of water, keeping this barrel warm and agitating it by the insertion of a steam pipe near the bottom. Salamanders were used for placing each floor. When the forms for the columns and floors were in position the entire building was surrounded with canvas reaching up and over the wall beams and hanging down below the floor underneath. As many as forty salamanders were used in the area of the building, which approximates 6,000 square feet of floor.



The construction plant of the builders was located at the north side of the building. The concrete was mixed and hoisted in a regular Aberthaw hoisting bucket to the point desired, the contractors using their iron hoisting tower. This tower was equipped with boom, which raised the steel and centering to the upper floors. The distributing of the concrete was done with V-shaped Koppell cars, the length of carriage from the mixer to the point where it was placed on the job in question averaging less than 100 feet.

The owners are particularly well satisfied with this building and are hearty in their endorsement of this type of reinforced concrete construction.

J. C. Willey has started to manufacture concrete blocks at Shellrock, Iowa.

J. T. Keenan has opened a factory at Rush City, Minn., for the manufacture of concrete blocks, silos, etc.

BEAUTIFUL PORCH COLUMN MOULDS AND ORNAMENTAL MOULDS OF EVERY DESCRIPTION.

Every concrete worker or builder is in business for money and everything that will help to earn two dollars where before only one was made should receive the most careful consideration, writes Northwestern Steel & Iron Works, 1080 Spring street, Eau Claire, Wis. A good porch column and baluster outfit, lawn vase, hitching post, jardiniere, and other similar ornamental articles will make several hundred per cent on every sale and offers big possibilities to the concrete workers. Read what a set of "Northwestern Porch Column and Baluster Outfits" has done for one man. It not only netted him splendid profits on the moulds themselves, but greatly increased his business in other lines. Every porch column or ornamental mould that you produce will serve as a piece of advertising to bring you more. Get in touch with the largest manufacturers of this line of goods in the world and secure a copy of their latest catalog showing the latest in the concrete machinery line.

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Regardless of what you might be in need of, you are sure to find it listed in our 1911 Concrete Machinery Catalog, which is the largest and most magnificent publication of the kind ever issued. There are hundreds of different articles shown and no one should think of making any purchases in this line until they have a copy of this book. It will serve as a reference for making your future purchases and show you the prices you ought to pay. Block Machines, Brick Machines, Tile Moulds, Fence Post Machines, Sewer Bend Machines, Ornamental Moulds of every description, Tools, Wheelbarrows, Crushers, Sand Screens, Water-proofing, Mould Wash, Block Laying Tools—everything in this line is shown.

Don't fail to send for this catalog today and get our special proposition of prices and terms. Sent free to readers of Cement & Engineering News.

W. H. Graham and H. K. Marshall of Los Angeles are in Lodi, Calif., looking over the ground, with the purpose of starting a factory for the manufacture of concrete pipe to be used for irrigation purposes. They have been operating such a plant with great success in the southern part of the state for the past nine years and they believe that they can make an even bigger success with such a factory here. They have opened offices in the Atwood building, and it is their desire that landowners and others discuss the proposed factory with them, so that they will be able to get a line on how great a demand for their product they will find in Northern San Joaquin. The concrete pipe is said to be very reasonable in price and it does away with open ditches and the resulting loss of tillable land and loss of water by evaporation. Also it provides sub-irrigation instead of surface irrigation.

James H. Corbett's 60-Ton Marion Shovel, Manufactured by Marion Steam Shovel Co., Marion, O., on the Pittsburgh & Shawmut Railroad at Markton, Pa. The Rock in Dipper Weighed Eight Tons.

CHARLEVOIX ROCK PRODUCTS CO.

The Charlevoix Rock Products Company has ordered the construction of two more lime kilns of the same pattern as those now in use at Charlevoix, Mich. The ponderous machinery, embracing the 500 horse power engine, 400 horse power electric generator and titanic crusher, have been placed and are ready for work when the remainder of the machinery arrives.

The company's enterprise is no longer experimental. Orders far exceed the capacity of the plant, and the product is giving the best of satisfaction to buyers. Seventy-five men are now employed, and the force will be increased to 100. When the plant is fully completed the payroll will number 125.

The Roux Composite Brick Company, of Plant City, Fla., which was capitalized recently at $30,000, has taken over the plant of the Plant City Sand-Lime Brick Company, and, under the direction of W. J. Carmichael, manager of the American Clay Machinery Co., of Willoughby, Ohio, has installed sand-lime brick machinery of the latest type, and is now turning out a very superior grade of sand-lime brick. The plant has a capacity of something over 50,000 brick per day.

The Pergola—It's Mission

When we speak of point lace, we instinctively think of Ireland; the same is true of tulip bulbs and Holland, both in their own way suggestive of beauty, but to Italy, the land of art and architecture, appropriately belongs credit for the introduction of the pergola.

The Pergola originated there. It was an added note of beauty to the general plan of Italian home and garden architecture. Other features that recommend the structure were undoubtedly recognized by the Italian, but its artistic possibilities were considered the most important.

Without losing sight of the chief reason for its origin, it remained to the more practical Britisher to adopt and develop the pergola from a different viewpoint.

Its restful and satisfying influence was in strict accord with his idea of home environment; sheltered and protected from the highway, it afforded the family the seclusion which characterizes the British home, while it placed no restraint whatsoever upon the native enthusiasm for outdoor life.

Concrete Lawn Seat.

In America, up until recent years, the pergola had a much harder task in finding popular favor. The free and easy manner of the people was in direct contrast with that of their European cousins and consequently the proverbial front porch was not going to be readily superseded.

Usually situated within hailing distance of the sidewalk, without even the semblance of a hedge-fence between, the front porch permitted of the exchange of greetings and of discussion of the live topics of the day with passing friends. The disadvantages of such a congenial rendezvous were thus, for a time, overlooked, and in the meanwhile the pergola made but slow progress.

A keener appreciation of the benefits to be derived from a closer association with nature, however, particularly noticeable in America, emphasized the merits of the pergola and practically resulted in the abandonment of the old style porch, which, with its solid roof, unduly darkens the entrance and excludes both sunshine and fresh air, which would otherwise find their way into the first story of the home.

Thus, in line with the modern idea of sanitary environment, we find provision made for the dignified and artistic pergola-porch, the sun parlor, the solarium, the outdoor living-room, sleeping-chamber and the pergola, a boon which is also enjoyed by the city dweller, the present-day apartment building, being equipped with one or more of these features considered essential in the matter of right living.

In design the pergola varies to as great an extent as do the materials with which it is built, nevertheless the element of beauty is always present. The square stone piers, supporting a frame work of timber, is responsible for the grandeur of the Italian structure. Rustic work, which never fails to attract and please the eye, is generally followed in England, the pergola there consisting of larch poles, supported on stout wooden posts, while the concrete pergola is naturally of a distinctly American type.

In California, where things artistic are seen at their best, the pergola is frequently built of redwood logs,

For the Garden—Pedestal and Flower Urn of Concrete.

but here in Northern climes, the use of a material is necessary that will withstand the damaging effect of our severe winters without detracting in the slightest degree from the artistic element of the structure, nor from its brightness, its lightness of color, which is likewise essential, so as to contrast properly with the foliage and blossoms, with which it is entwined.

Concrete, therefore, appeals to the American. Its permanence is undisputed. It may be molded to any detail, no matter how fastidious the prospective builder may be, and its cost is not prohibitive to the home-owning citizen. It may be dark or it may be light of color, much depends upon the materials with which it is made, but if care is exercised in their selection as is necessary, in choosing the pergola site, and again necessary in planting the vines and creepers around the columns, so that the structure becomes a part of and harmonizes with the home itself and the surrounding trees and shrubbery, then the possibility of spoiling the landscape with a structure of "lifeless" appearance is readily overcome.

The concrete pergola thus appeals to so many people in so many ways that it is destined to find a permament place in the American home and garden. Unlike the front porch, it gives an atmosphere of privacy to the home, it invites relaxation from our labors in this workaday world, it brings us in closer touch with nature and affords the children a playroom outdoors, yet well within the zone of safety.

Exhibit of the Chicago Portland Cement Co., at the Sixth Annual Chicago Cement Show. "CHICAGO AA" Portland Cement Used. Designed and Built by the Peoria Trusswall Mfg. Co., Peoria, Ill.

Pergola Foot Bridge at Moline, Ill., John Good, Owner. Designed by H. C. Klehm, Arlington Heights, Ill. Contractor, Antoni Swenson, Silvis, Ill. "CHICAGO AA" Portland Cement used.

Entrance—Lighting Standard of Concrete.

Pergola Table of Concrete.

Sun Dial of Concrete.

It cannot always serve the same purpose as does the "spite" fence, yet frequently it is employed to obscure from view that which is unsightly, a mission it fulfills admirably when built in harmony with other existing conditions, without losing any of its artistic or ornamental effect, or the simplicity, charm and dignity, which has made and makes the structure a source of everlasting joy and pleasure, to family, friends and neighbors alike.

Above is illustrated the exhibit of the Chicago Portland Cement Co., Chicago, installed at the Sixth Annual Chicago Cement Show. It was designed and built by the Peoria Trusswall Mfg. Co. of Peoria, Ill. "CHICAGO AA" Portland Cement being exclusively used, and besides consists of table, lawn seat, sun-dial, flower urn, pedestal and lighting standards in concrete.

The system of construction followed, known as the "Trusswall" system, is unique, in that the concrete is not poured, but is turned, the lathe and metal templates superseding the form or mold, heretofore used in work of this character.

A collapsible core is used in the work of construction. This core is first placed in the lathe, fully protected with paper to prevent the concrete adhering to it. An even coat of concrete is then applied and allowed to partially set.

The reinforcing is next placed. This consists of wire, or wire and rods, of a suitable gauge, thickness and quantity, to carry the desired load. The wire is wound from end to end of the shaft, at an angle of about forty-five degrees, by revolving the shaft, thus forming a diamond mesh, which covers the entire column.

When additional reinforcement is necessary, rods are placed lengthwise, from end to end of the shaft, and these are again covered with a second layer of wire, in the manner already described.

The final coat of concrete is then applied, turned and permitted to set, after which the core is withdrawn from the finished column.

Under this system, which has gained wide recognition among architects (and purchasers likewise express satisfaction in the work), a column may be produced in concrete of any size, to any detail, thoroughly waterproof, not unduly heavy as it is hollow, symmetrically correct and without mark or blemish.

The same method of construction is followed in building the table, lawn seat, sun-dial, flower urn, pedestal and lighting standards, all of which are reproduced in these pages. Worthy of special mention is the table and the lighting standards. The former is produced in five colors and illustrates to good advantage the possibilities of inlaid work, while the latter may be readily equipped with three or five light clusters.

CONCRETE ROADWAYS.

Mr. J. A. Hudson of Columbia, Mo., Chairman of the Columbian Special District Road Commission, speaks of the concrete roadways, which are to be constructed in the vicinity of Columbia, as follows:

"I have studied the three forms of roadways now in use—the earth road, the macadam road and the gravel road—and have come to the conclusion that the earth road is the best nine months in the year. The other three months in the year, usually the latter part of the winter, when the frost is coming out of the ground, they are likely to be covered with mud.

"The gravel and macadam roads require constant care to keep them in order. They have to be resurfaced every six months, or at least once a year.

"Roads which the commission have been considering for Columbia district will be 30 to 32 feet wide and will be of the ordinary earth-road construction. Down the center of the roadway will run a strip of concrete 7 feet wide. This is the concrete driveway system which we intend to introduce.

"The cost of constructing these driveways will approximate the cost of gravel roads in our district, about $3,500 a mile. Figuring the absence of the maintenance cost, you can see that quite a saving will be effected.

"We have twenty-five miles of gravel roads in our district at present. Twenty-five additional miles will be constructed on the concrete driveway system if our plans turn out as we expect."

TWO VALUABLE BOOKS.

Two instructive and valuable books have just been published by the Norman W. Henley Company, and copies may be had at 50 cents each upon application to Cement & Engineering News, 1117 Schiller Bldg., Chicago. One of the books is entitled: "Moulding Concrete Flower Pots, Boxes and Jardiniers," by A. A. Houghton. The molds for producing many original designs of flower pots, urns, flower boxes, jardiniers. etc., are fully illustrated and explained, so the worker can easily construct and operate same. A new method of making plaster molds with the formulae for the compound, which has all the smoothness of a glue man standing on a platform at the top, and he regulates the flow of the concrete through the spouts.

Twelve men are used in this plant, including those that load the loose material in the mixer, engineers connected with the mixer and hoisting engine, and those that spread the finished concrete. A ½ yard mixer is used, and an average of 18 to 20 cubic yards per hour or 150 cubic yards to a day of eight hours is being turned out.

CONCRETE BRIDGES.

Universal Portland Cement Company, 72 West Adams street, Chicago, has just issued an interesting booklet on concrete bridges, with numerous illustrations and descriptive matter of bridges that have been built in various part of the country. A copy will be sent free of charge by mentioning Cement & Engineering News.

J. B. Millard & Son, of Lebanon, Pa., are employing over 100 men in the large quarry operation in Marion township, two miles west of Stouchsburg, Pa., having 40 acres of ground, part of which was formerly part of the Tulpehocken Reformed Church farm. High-grade calcium limestone is being quarried. This stone is found excellent in building roadbed. The crusher, which is well equipped, reduces 1,000 tons of stone a day.

Another industry for Durand, Mich., is to be established this fall, to be a tile and cement block factory. George Johnson and Ernest MacLachan are the promoters and proprietors. They have purchased the tract of land of several lots lying on Oak street. Machinery will be installed for the making of modern cement tile blocks, water tables and other articles used in building and draining with cement products. The proprietors believe there is an opening in the manufacture of these articles and will give the business their personal attention.

Among The Cement Mills

CEMENT MILL NEWS.

John G. Berquist, works manager, of the Universal Portland Cement Co., has resigned that position. A connection with the company will be maintained by Mr. Berquist who will hereafter act in the capacity of consulting engineer.

Leonard Wesson, superintendent, Plant No. 2, South Chicago, Ill., has been transferred to the general office of the company to assist President Edward M. Hagar in matters relating to appropriations, construction and operation. Mr. Wesson will have the title of assistant to president.

Nels Nelson who has been assistant superintendent of Plant No. 2, has been promoted to the position of superintendent of that plant.

The Crescent Portland Cement Company, Wampum, Pa., has ordered a Dodge Eureka water softener and purifier from the Dodge Manufacturing Company, Mishawaka, Ind. The machine will be rated 170 gallons per hour.

TO MAKE REPAIRS.

The Alsen Cement works will shut down for their annual repairs on December 24th. The repairs will be completed by January 15, when work will be resumed. Usually six weeks is required for the repairs, but the concern has but little cement on hand, and therefore the work will be hurried in order to resume grinding as soon as possible.

The Inland Engineering & Construction Company, Asotin, Washington, has been incorporated, and is doing a general engineering and contracting business. The personnel of the company is F. W. Freeborn, of the Freeborn Engineering & Construction Company, Kansas City, J. O. Edson and L. C. Wilson. The last named is superintendent of construction. The company will make a specialty of cement plants, power plants, etc. It is at present erecting a cement plant for the Idaho Portland Cement Company at Asotin.

CEMENT DUTY RESTORED IN CANADA.

Today, through Government orders, the former duty on cement is restored. During the four months remission nearly 800,000 barrels of cement were imported, mostly from the States, an increase of nearly 400,000 on the previous four months.

NEW CEMENT MILL STARTED.

With approximately 100 men employed at its plant near Trent, eight miles east of Spokane, and between 50 and 60 at its quarry at Lakeview, Idaho, the International Portland Cement Company began operations last week. As it now stands, the mill and quarry of the International Portland Cement Company represent an investment of approximately $1,000,000. Of this amount about three-quarters has been expended in the construction and equipment of the mill, and the remainder at the quarry. The plant will have a capacity of about 500 tons per day and it is expected to be ready to begin shipments within the next two weeks. A number of houses for employes have been constructed at Trent and it is expected that building operations will be continued at that place throughout the winter and spring.

MAKING RAPID PROGRESS.

The plant of the Arizona Portland Cement Company, near Phoenix, Ariz., is rapidly nearing completion and will probably be turning out the finished product by the first of the year. Nearly everything is in except the electrical machinery and it is nearly ready for shipment. There will only be five or six more cars of machinery to install, including the electrical, until the plant will be ready to run. President O. M. Connet, realizing that if he here equaled his Kansas record of making and marketing nearly a million barrels of cement without having one car rejected, he must have experienced men at the head of each department, brought with him eleven of the best men of the Kansas cement field, most of them having been with him for a number of years.

R. V. Allen, his superintendent, says: "We will soon have the plant completed and it will be first-class in every particular. There are larger plants in other places but none better. I have worked in and had charge of a number of plants and know. It is my opinion we will have to enlarge our capacity in order to take care of the demand."

O. A. Bayless, the chemist, has his laboratory fitted up at the plant and from repeated tests of the raw materials finds that they are perfect for the making of a high grade Portland cement, which will be the equal of the best made anywhere.

GOES WITH OLD MISSION COMPANY.

Elvin U. Leh has resigned his position with the Cowell Cement Company to accept that of manager and chief engineer in the construction and operation of the plant for the Old Mission Portland Cement Company, San Juan Bautista, Cal. He stated that this company has located on its property the largest and most satisfactory deposits of limestone and clay in the state of California, as well as a supply of fuel oil.

TEXAS PORTLAND CEMENT CO. IS SUED BY STATE.

Attorney General Walthall, Austin, Texas, on behalf of the state, this afternoon filed an anti-trust suit against the Texas Portland Cement Company, headquarters at Dallas; Southwestern States Portland Cement Company, headquarters at El Paso, and the Alamo Cement Company, San Antonio, for penalties aggregating $1,900,000 for the alleged violation of the anti-trust law of 1903 and its amendments.

The state alleges that these companies have combined in restraint of trade by the fixing of the price at which cement shall be sold.

The suit was instituted in the Twenty-sixth district court before Judge C. A. Wilcox, and the state asks for an injunction and the appointment of a receiver to take charge of the property of the defendant companies. The period alleged in which these concerns are charged with fixing prices covers two years.

IOWA A CEMENT PRODUCING STATE.

Iowa has leaped to the front as a cement producnig state. This is shown in the annual report of the Iowa State Geological survey of the mineral industry of Iowa. The statistics were given out a few days ago by Prof. George F. Kay of the State university, state geologist. The output from three up-to-date Portland cement plants totalled almost $2,000,000 during 1911. The report further says, "When it is considered that previous to 1906 Iowa produced no cement it will be seen that the industry has made rapid development. Iowa is rich in material suitable for cement making."

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By the Quality and Quantity of Drain

Tile it will turn out right in *your own plant*

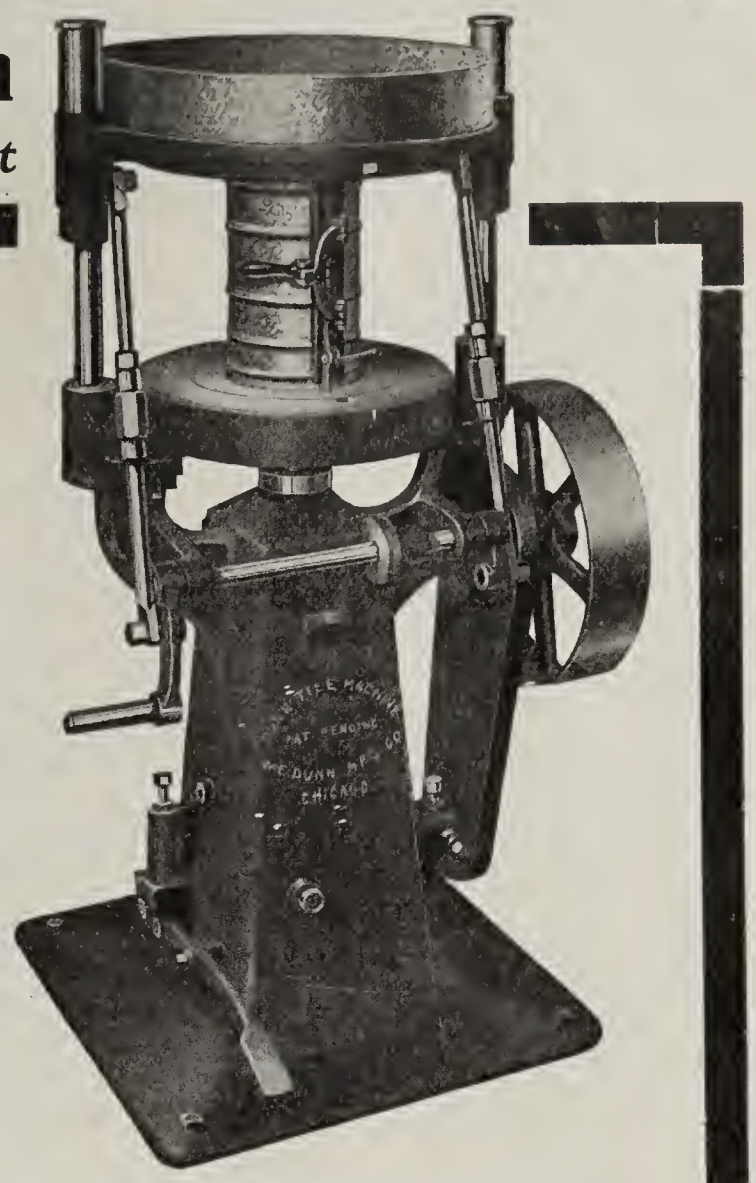
We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

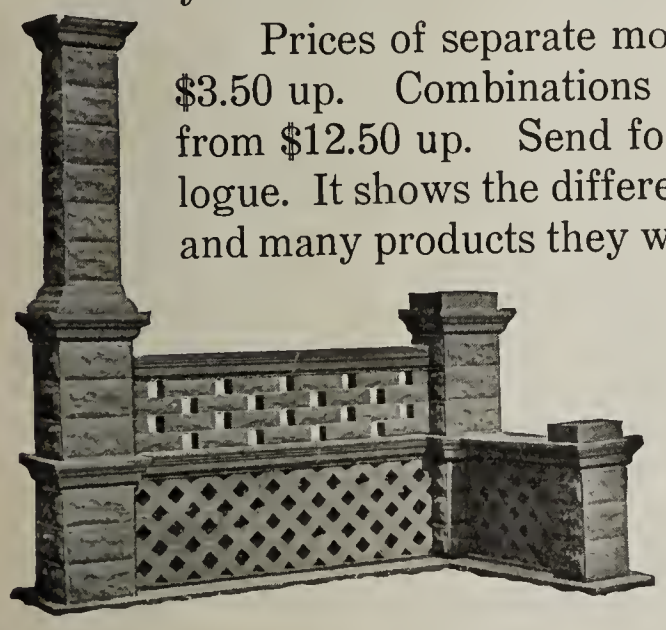
We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.



PRICE, $175

Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.



Prices of separate molds from $3.50 up. Combinations of molds from $12.50 up. Send for a catalogue. It shows the different molds and many products they will make.

Poured Sewer Pipe Molds

No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

W. E. DUNN MFG. CO.

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CHICAGO

Among The Cement Mills

SWINDLE CHARGE.

Involved financial transactions aggregating $120,000 brought four former officials of the Empire Portland Cement Company into the toils of the government yesterday. The men are charged with having swindled hundreds of cement dealers throughout the country. They are: Albert H. Marshall, Chicago; Albert T. Kirk, Shell City, Mo.; Harry W. Williams, Sheboygan, Wis., and Arthur G. Marshall, New York.

A "blanket" indictment against the four men was returned by the federal grand jury last Wednesday, but was suppressed for service. Marshall appeared at the Federal Building yesterday and secured his freedom on a $10,000 bond.

Kirk, Williams and Arthur G. Marshall were also arrested and released on $10,000 bonds each.

The indictment charges that the men incorporated the Empire Company in South Dakota in November, 1910. The capitalization was given as $2,500,000, and offices were opened in Chicago and Cincinnati.

Stock was sold to cement dealers at par. For every share of preferred stock purchased the dealer was promised its equivalent in cement. This, however, according to the federal authorities, never went beyond a promise, and many of the dealers are still anxiously awaiting the arrival of their cement.

It is charged that the company represented its financial rating as $500,000, of which $300,000 was invested in a plant at Portsmouth, O. According to the indictment, only $25,000 was invested in this plant, but despite this the officers managed to mortgage the property for $142,000.—[Chicago Record Herald.]

NEW CEMENT MILL FOR DULUTH.

The plans of the Universal Portland Cement company, which is about to erect a large plant for the manufacture of its product in Duluth, will soon be announced, it is given out from sources which are well informed, says the Duluth Tribune.

A few days ago some of the officials of that company were in the city and visited the proposed site of their Duluth plant. This is within the inclosure of the Minnesota Steel company's plant grounds, to the northeast of the other buildings. The details of the cement manufacturing plant are not yet available, and the plans are still in the hands of the president of the company in Chicago, but, as has been said, will soon be given out.

It is known, however, that the plans call for a plant of sufficient capacity to produce 1,000,000 barrels of cement a year. That the plant will be extended later, and perhaps doubled before long, is considered more than likely.

OLD MISSION TO BE COMPLETED.

Work on the completion of the great plant of the Old Mission Portland Cement Company at San Juan, San Benito county, California, has begun. A crew of 40 men is now engaged on the excavation for the lime kilns, which the engineers have located directly south of the cement plant. The foundations of the latter are now in place, and only awaiting the installation of the machinery, which is on the ground.

Together with railroad extensions, the value of lime, lime rock, clay and oil deposits, and the cost of installation of machinery and building construction the plant will represent, on completion, an outlay of $3,500,000.

Engineers estimate that the materials on the ground, in sight, are sufficient for the manufacture of 600,000,000 barrels of cement, this taking into consideration only the limestone above the first bench plane now being stripped for the operation of steam shovels.

The lime kilns will be in operation in about 90 days, but it is estimated it will be six months before the first unit of the 4,000-barrel cement plant will be fired.

CREDITORS ASK FOR SALE.

Creditors of the Great Western Portland Cement Company, whose plant is at Mildred, Allen county, Kas., yesterday filed a petition in bankruptcy in the Kansas federal court, asking that the corporation's property be sold, and outstanding claims settled. The company was organized in 1907 with $3,000,000 capitalization. It did a prosperous business until the cement war was declared, when the prices of cement went far below a profit-making margin.

Frank L. Travis of Iola, Kas., was named receiver for the company October 26, following an equity suit in the federal court at Fort Scott, in which the Commerce Trust Company of Kansas City sought to collect $3,000. The liabilities of the company are declared to be $330,000.

The petition was filed the other day by Edwin A. Krauthoff, representing the creditors. A. L. Berger represents the receiver, and Charles W. German the corporation.

RESIGNED.

Mr. C. M. Dugan, Jr., general manager, Kosmos Portland Cement Co., Louisville, Ky., has resigned his connection with that company to take effect January 15th, 1913. Mr. Dugan expects to spend the winter along the Gulf coast, and later to go north and enter the engineering and contracting field.

B. H. Traster, Syracuse, Ind., writes us that he is a blacksmith with three years' experience as a helper in cement factory and six months' experience as a railroad smith, but at present is out of employment and would like to hear from parties in need of such a man.

A plan of reorganization of the American Cement Company and its subsidiary companies has been prepared by the general reorganization committee and submitted to all holders of securities, and deposits of securities are now being received by the Girard Trust Company, Philadelphia. Charles J. Rhoads, chairman of the general reorganization committee, has requested all holders of securities of the American Cement Company, Reliance Cement Company and Norfolk Portland Cement Corporation to send in their names and addresses so that copies of the plan of agreement of reorganization may be mailed to them.

The Allentown Portland Cement Company's plant at Evansville, Pa., in charge of A. E. Douglass; is enjoying a very brisk season, with the assurance that between 140 and 160 men will have steady employment all winter. The present output is 80,000 barrels a month. Shipments are averaging thirty carloads a day. Orders are coming in steadily and the plant has never had a more vigorous fall season. The prospects for 1913 are extremely good.

Increase the Life of Screw Conveyors

handling abrasive or gritty materials by using the

DRUMMOND END FLIGHT

Drummond End-Flights with coupling gudgeon assembled complete
The removable cap is omitted from the right end to show detail of arrangement

The Drummond End Flight effectively prevents wear of screw conveyors, particularly at the end flight and prolongs the efficiency of the entire equipment.

It also eliminates the troublesome and tedious operation of removing gudgeons and flight sections for repairs to screw conveyors, which always entails a loss of time and output.

Full particulars in new Bulletin No. 154
Address nearest office.

This clever device is the invention of the late D. D. Drummond, Vice-President and General Manager of the Chicago Portland Cement Co., and widely known as one of the ablest engineers in the Cement Industry

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Modern Manufacture of Portland Cement
A Handbook for Manufacturers, users and all interested in Portland Cement 255 Pages Cloth Bound
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Among The Cement Mills

At the annual meeting of the Bath Portland Cement Company, in this city, Samuel Clark, of Newark, N. J., was re-elected president; B. F. Stradley, first vice-president and treasurer; Louis Raffeto, of Philadelphia, second vice-president, and Fred B. Franks, secretary and general manager. The plant has been very busy during the year producing more than a million barrels of cement.

President John W. Eckert, of the American Cement Company, has ordered a large force of men to begin making repairs on the company's mills at Egypt, Pa., with the expectation of resuming operations immediately after the final meeting on reorganization proceedings.

The plant of the Alabama Portland Cement & Lime Company, located at Spocari, Ala., will be enlarged. Among the added equipments will be the installation of a kiln 175 feet long by ten feet in diameter.

W. W. Rhodes, chemical engineer, is now connected with the Woodville Lime & Cement Company, Woodville, Ohio., and in addition to his duties as chemist has taken charge of the manufacture of Alca-lime plaster, which is one of the principal products of the Woodville concern. Mr. Rhodes was formerly chemist of the Berkeley plant, Security Cement & Lime Company and of the Blair Limestone Company.

Gold Williams, sales manager of the Marquette Cement Manufacturing Company, says: "Last year mills at this time of the year had their bins full of cement, with no special demand in sight for the coming spring. This year mills go into winter with empty bins, and with prospects of a greater demand for cement the coming spring than we have had for the last six months. The demand next year will undoubtedly be so heavy that it unquestionably will protect the dealer and manufacturer alike against the severe competition that existed the forepart of this year. There is every reason to believe that prices will not fluctuate so much as they have this year, and will be nearer on a level approximately close to the prices which ruled for cement the last six months. With regard to the results of the presidential election and the change of administration next March, no fear or anxiety is felt, and the fact that we are now spending two hundred thousand dollars immediately after the election, increasing our facilities in both the raw and finished ends, speaks for itself. Our shipments this month have been heavier than we expected. The car situation is becoming relieved to some extent, and we are looking for great prosperity next year, which will increase consumption of cement materially over that of the year now closing."

CEMENT USED ON PANAMA CANAL.

When the latest million barrels of cement purchased have been used in construction work on the Panama Canal, the amount of cement employed in the building of the big ditch will have reached a total of 2,300,000,000 pounds. The cost of this item of construction reaches $6,500,000. If the barrels which contained the cement could be placed end to end they would extend 2,300 miles.

The bondholders' committee of the Atlantic & Gulf Portland Cement Company, Ragland, Ala., has extended the time for deposit of 6 per cent first mortgage bonds, under the plan of reorganization, to November 15. The plan proposes that in lieu of the present $1,500,000 of first mortgage 6 per cent bonds there is to be issued in exchange an equal amount of adjustment mortgage bonds, this mortgage, however, to be postponed and deferred to a first mortgage to secure an issue of $400,000 first mortgage 6 per cent gold bonds, which shall be sold at par and the proceeds used to retire the present floating indebtedness of the company and provide a free working capital of approximately $100,000.

Every person employed at the extensive works of the Security Cement and Lime Company, near Hagerstown, Maryland, has been vaccinated.

On account of the demand made for cement the Northwestern Portland Cement plant of Mason City, Iowa, which has been in the habit of shutting down during the month of January so that repairs can be made, will not do that this year. Parts of the plant will be shut down where repairs are imperative, but all work that can be done will be with the plant in operation. Both the Northwestern and Lehigh will go it at full blast all winter.

A STANDARD SULPHUR TRIOXIDE CONTENT FOR PORTLAND CEMENT.

The sulphur content in Portland cement has been the subject of contention for many years among experts and engineers, the addition of gypsum to Portland cement for the purpose of regulating the set being the element from which the controversy grew. Various governments in their specifications have adopted various standards for sulphur trioxide, as shown in the article below. The paper which follows is the production of the German Portland Cement Manufacturers' Association and is a valuable contribution to the discussion of this important subject.

The article contains the results of numerous tests made under the Standard German specification with cements where the So_3 content had been raised to 2.50% by suitable additions of crude gypsum. The experiments were carried on over a period of two years and tables are given to show the behavior of the various test pieces under the different exposures. The paper follows:

Portland cement is known to contain small quantities of sulphatic salts, originating partly in the raw materials and coal, and partly added, in the form of crude gypsum (hydrated calcium sulphate), in the process of grinding the calcined cement, for the purpose of controlling the time of setting. The total content of sulphates in a cement is generally stated in terms of sulphur trioxide (SO_3).

These small quantities of sulphur trioxide occurring in normal Portland cement are quite uninjurious to its practical application; and it is only when the amount exceeds a certain limit that, during storage under water, a supplementary expansion—which may sometimes be dangerous—occurs in the hardened cement, owing to the formation of calcium-aluminium sulphate. This substance is also formed when the amount of SO_3 is small, but in such event helps to increase the strength of the mass by making it more compact.

When the standard specifications of quality and testing of Portland cement were redrafted in Germany the maximum permissible limit of SO_3 was fixed at 2.5% on the basis of extensive experiments.

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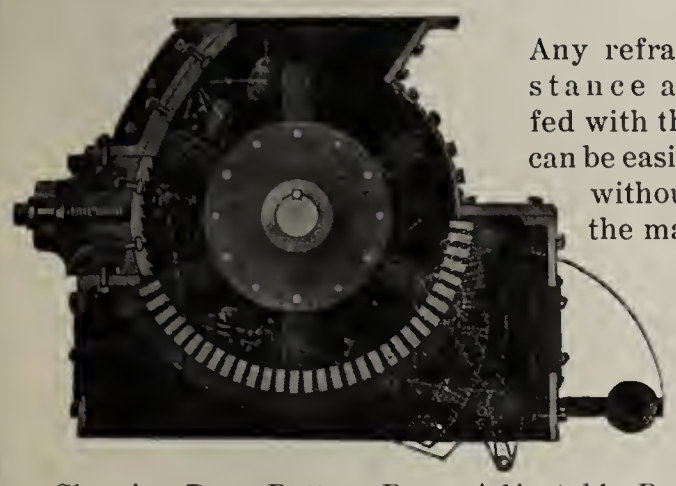

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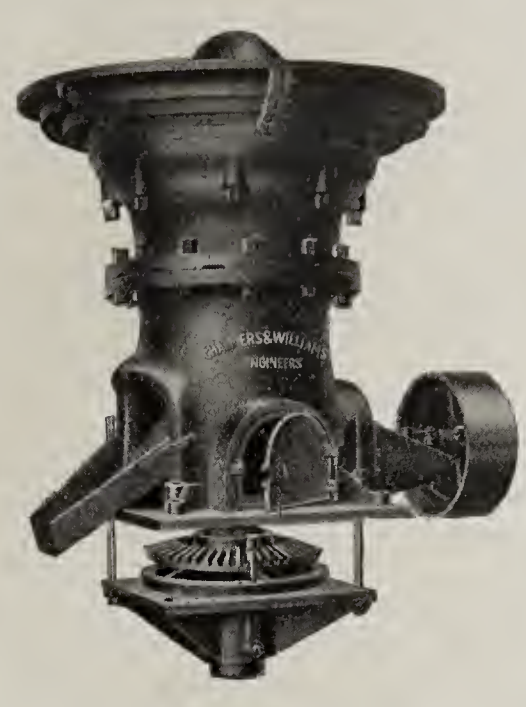

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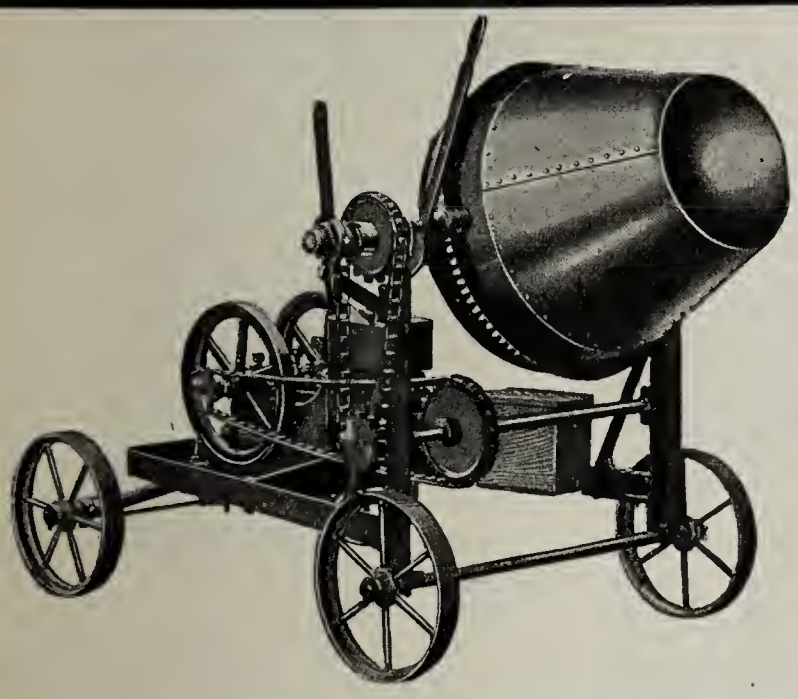

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Among The Cement Mills

In other countries the following maximum limits are in force:

England	2.75% SO_3
Austria	2.50% SO_3
Canada	2.00% SO_3
United States	1.75% SO_3
Russia	1.75% SO_3

In the countries named below the limit differs, according as the cement is to be used in fresh or salt water:

	Fresh water.	Salt water.
France	3.0%	1.5% SO_3
Brazil	3.0%	1.5% SO_3
Japan	2.0%	1.5% SO_3
Argentina	2.4%	1.2% SO_3

There is, however, no reason why the amount of SO_3 prescribed for fresh water should act differently when the cement is hardened in salt water. In hardening in fresh water an amount of SO_3 slightly exceeding 2% produces a very small degree of expansion by the formation of calcium-aluminium sulphate; and the same process occurs when the hardening takes place in salt water. This minute expansion cannot have any injurious results. If, however, the sea water (containing magnesium sulphate) is able to penetrate into the cement mass permanently—which happens principally in the case of cement that is not compact—the result is that the cement is attacked. In the opinion of various investigators, the magnesium sulphate of the sea water combines with the lime in the cement to form calcium sulphate and magnesium hydroxide. This latter is deposited in the pores of the cement, while the calcium sulphate forms calcium-aluminium sulphate with the alumina of the cement, a large quantity of water of crystallization being absorbed. In the event of the action of the sea water being continuous, the considerable expansion resulting from the above-named reaction may lead to the destruction of the mass. Hence, it is not the small percentage of SO_3 in the cement which plays a part in the destruction of the mass, but the magnesium sulphate that penetrates continuously from the sea water into the porous cement mortar. This point has been always emphasized by the German Portland Cement Manufacturers' Association, and the late Prof. Dr. W. Michaelis also mentioned it specially at the last general meeting of the association.

We will not now go into other possible causes of the destructive action of sea water, wishing to confine ourselves exclusively to the action of sulphuric acid. We must not, however, omit to mention—as he has, moreover, been insisted on frequently and by different authorities—that, in structures exposed to sea water, the mortar used must be as compact as possible in order to prevent the sea water from penetrating the structure, and to enable the latter more effectually to withstand chemical and mechanical influences.

In order to establish beyond doubt that the percentage of 2.5% of SO_3, as allowed in the German specification, is quite unobjectionable; and more particularly in view of the fact that the Argentine specification has recently increased the SO_3 limit from 1.0% to 1.2% in cement for marine structures; the German Portland Cement Manufacturers' Association in 1907 arranged with the Royal Laboratory for Testing Materials, Gross-Lchiterfelde, for the performance of tests in this connection, over a period of 10 years, at the island of Sylt in the North Sea.

*Presented at the Sixth Congress of the International Society for Testing Materials.

The materials used consisted of a Portland cement (S) containing 1.19% of SO_3 and employed for all purposes, marine structures included; and another Portland cement (B) which contained only a very small proportion of SO_3, namely 0.57%. Owing to this low percentage this cement is specially preferred in France for marine structures, e. g. in the harbor at Boulogne, and more particularly in Argentina. It was supplied to the Royal Testing Laboratory by the makers.

The following test pieces were prepared from these two cements, both in their original condition as received and after the SO_3 content had been raised to 2.5% by suitable additions of crude gypsum:

1. Compression-test cubes (7 cm. side) mixed in the proportions 1:2 and 1:4 with Sylt sand for hardening in sea water, fresh water and the open air. Length of hardening period: 28 days, 1 year, 5 years and 10 years.

2. Blocks of about ¾ cbm. capacity, composed of a mixture of 1 part cement, 2 of sand and 3 of stone chippings. After being hardened for 6 months in the air the blocks were laid into the quay wall, where they are exposed to the chemical action and full force of the North Sea waves.

3. Plates measuring 50 by 50 by 8 cm., mixed in the proportions 1:2 and 1:4, half of them being hardned for 4 months and the others for 6 months in the air, and then laid in the harbor dam at Munkmarsch, where they are exposed to intensive action on the part of the water and weather in consequence of the semi-diurnal ebb and flow.

Summary of Results.

1. The tensile tests showed that the presence of 2.5% of SO_3 (sulphur trioxide) in Portland cement is thoroughly harmless during hardening in sea water.

2. The examination of the large blocks immersed in the North Sea and of the plates in the Wattenmeer has shown that the cement, which was richer (1.19%) in SO_3, behaved well, both in its original condition and after enrichment to 2.5% of SO_3; while the cement with the lower SO_3-content (0.75%) and supplied specially for marine structure behaved badly, and was even improved by enrichment to 2.5% of SO_3.

3. The chemical examination of the plates failed to reveal more than slight alterations due to sea water in the case of the cement with the higher SO_3-content, whether in its original condition or after enrichment. The cement lower in SO_3 and used in its original condition was found to have sustained extensive chemical changes under the action of sea water, though only to a smaller extent when enriched to 2.5%.

From these results it follows indubitably that the presence of up to 2.5% of SO_3 in Portland cement produces no injurious effects of any kind, whether in sea water or fresh water.

Moreover, the favorable experience that has everywhere been gained in marine construction works with cements of this kind, namely containing a higher percentage of SO_3 than is prescribed in countries which issue special specifications for such works, demonstrates that the higher SO_3-content of the cements in question has not led to any injurious effects in practice, provided the cement has been properly used.

Consequently, the German Portland Cement Manufacturers' Association, on the basis of the material set forth above, requested the International Association for Testing Materials to lay the following resolution before the Sixth Congress of the International Association, in New York, for examination and adoption:

CEMENT

... AND ...

ENGINEERING NEWS

WEST BRIDGE, COLUMBIAN PARK, LAFAYETTE, INDIANA.

Span of Waterway, 30 Feet.

For the Board of Park Commissioners, Lafayette, Indiana, 1902.

(Luten Design.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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CHICAGO, FEBRUARY, 1913

A FAIR PRICE FOR CEMENT.

During the past ten years the average price of cement at the mills has been, with few exceptions, remarkably low; in many instances below the actual cost of production. This has been true especially of the new mills coming into the market for the first time.

The reason for offering cement at so low a figure has been keen competition and consequently a desire to underbid other manufacturers. This aim led to a disastrous practice of miscalculation in figuring the cost of production, and, in the long run, turned out to be self-deception.

As long as the machinery was new and the plant operated without serious or costly repairs, the cost of production consisted mainly of conveying the raw materials from the quarries to the mill, submitting them to the various processes of reduction, of burning the mixture and of reducing the finished product to the required fineness and depositing it into storage bins. However, in estimating the various items constituting the cost of production the management mostly lost sight of the fact that the costly machinery employed in the process of grinding and burning quickly depreciated in value and that repair bills would be quite heavy after a number of years. Hence the low price of cement owed its origin chiefly to false estimates of the cost of production.

A fair estimate of the cost of production can be obtained only by making an ample allowance for maintenance and depreciation and no cement plant can be operated for any length of time on a commercial basis without overlooking this fact. The selling price of cement must be high enough to defray all necessary mill charges and to provide for occasional renewals and installation of improved machinery. Figured at this rate, a fair price for a barrel of cement at the mill would be one dollar, whereas a selling price of 60 cents or 75 cents, which has been customary for years at some of the large plants, is merely based upon miscalculation and must ultimately lead to bankruptcy, which it unfortunately has done in many instances.

Mills using gas for fuel, as for instance the Kansas plants, could safely make a lower price than $1.00 per barrel. Now, however, that the gas supply has been practically exhausted and powdered coal has to be used, these plants of the Middle West are in a less enviable position, as alone the low cost of production enabled them to ship their cement into Colorado, Idaho and even farther west and to compete with manufacturers of cement in those distant regions.

The Lehigh Valley is no longer the dominant figure in the cement industry, owing to curtailed markets and shortage of raw materials. Far-seeing eastern cement manufacturers for this reason have made in time provisions for the decline of their trade in the East by establishing cement plants in the Middle West, on the Pacific Coast and in Canada. Moreover, the Hudson River mills are giving the Lehigh mills the severest kind of competition in New York City, where the former, free from all railroad and lighterage charges, are able to lay down cement at less than 90 cents per barrel.

A noteworthy exception to the rule are, of course, the Portland cement mills operating in connection with the U. S. Steel Corporation's blast furnace plants. These enjoy cheap power generated from the waste gases of the steel mills and are, therefore, in a position to produce cement at a lower cost than any other mill in the country.

THE SIXTH CHICAGO CEMENT SHOW A SUCCESS.

The sixth Chicago Cement Show, held January 16 to 23 under the able management of J. P. Beck, has surpassed in attendance any previous exhibition of the kind in the country's history. This may be credited to the fact that the officers of the Cement Products Exhibition Company on this occasion have been able to put into practice the lessons gained by previous show experiences. The exhibitors likewise have learned how more effectively to arrange their displays.

It was the most practical and useful show that has ever been offered to the public. Here is what some of the exhibitors said on the last day:

"Certainly well pleased with results of the show. Have changed our plan and will go to Omaha Exposition and next year's Chicago Show."

"More than well pleased with business and attendance at the show."

"Found the crowds were more buyers than sightseers."

"Found the business closed was several times better than we expected. Will come again."

"Sold 15 mixers, which is more than we sold at any of the eight shows where we exhibited in 1912."

"This is our first show and we will be at the next."

"Did more business than last year, and are well satisfied with the show."

"Received 203 subscriptions; which is the best we have ever done at any cement show."

"We have done a larger amount of business than we expected."

"We found a class of trade we were anxious to reach, and are satisfied."

"We have lined up a number of good prospects."

"Business was good and outlook is great."

"The show was the best we have ever attended and business was good. In our line the trade knew just what they wanted, asked for it and got it. We

talked less and filled more orders than in previous years."

"We are more than pleased with this show and that means that we got our share of the business. We will be at the next show with 'bells on.'"

"Cannot afford not to exhibit."

"Cheap and efficient method of meeting the public."

"Meet many contractors and manufacturers who otherwise could not be reached personally or through advertising."

"Do not know where we could get so much advertising among interested parties at so low a cost."

"Turned down business offered at show because of a lack of facilities for manufacturing in large quantities."

"Wrote more orders than a year ago."

"Actual sales 30 per cent greater than last year."

"Interest shown by visitors greater than looked for."

"Have taken many new subscriptions, and have made acquaintances among manufacturers and contractors that promise well, both from the standpoint of advertising and subscriptions."

"Entirely satisfied with the business transacted."

"Sales beyond our expectation."

"Expenses not paid by subscriptions, but easily made up by new advertising."

"Business excellent."

"Sold out our output."

"Always an interested crowd around."

"Profiting by last year's show, kept a systematic record of interested visitors and a long one."

"At least 200 persons told that they believed the show this year eclipsed anything of the kind they had ever seen in Chicago, and hoped that the same interest would be shown next year by the exhibitors as was shown this."

SAND AND GRAVEL WORTH TWENTY-ONE MILLION DOLLARS.

One of the important industries in the United States of which comparatively little is written is the production of sand and gravel. In 1911, according to a report by E. F. Burchard, just issued by the United States geological survey, the production of sand and gravel amounted to 66,846,959 short tons, valued at $21,158,583. The production of sand of all kinds was 40,253,977 tons, valued at $14,438,500, and that of gravel was 26,592,982 tons, valued at $6,720,083. The production of glass sand was valued at $1,547,733, an increase over the figures for 1910; the sand used for building in 1911 was valued at $7,719,286, a slight decrease as compared with 1910. This was accounted for by less activity in 1911 in the building trades, including that of concrete construction. The production of molding sand in 1911 was valued at $2,132,469, a marked decrease as compared with 1910. The production of all other sands in 1911, such as sand for grinding and polishing, fire sand, engine sand, and filtration sand, was valued at $3,043,012, an increase of over a million dollars in value as compared with 1910.

COLUMBUS CHAIN COMPANY.

The Columbus Chain Company of Columbus, Ohio, has issued to the trade a revised catalogue of chains and saddlery hardware. This company's special "CC" dredge and "Hercules" solid weld steam shovel chains are known all over the world and are the best procurable where strength and wearing qualities are required.

CONCRETE FIREPROOF CONSTRUCTION.

In a recent statement, M. C. Tuttle, of the Aberthaw Construction Company, Boston, Mass., took exception to the generally accepted idea that concrete building construction was necessarily fire proof. He pointed out that it is an excellent fire retardent by reason of the fact that it is incombustible. Unless very carefully designed and erected, however, it is as liable to collapse in a severe fire as any of the other good fire retarding forms of buildings. The action of extreme heat upon the surface of a concrete wall or ceiling is to drive off from the material the water of crystallization and thereby demolish the bond and practically obliterate the tensile strength of the material. This action affects only a very thin surface film, so to speak, and this film, which may have a thickness of half an inch or more, acts as a good insulator to the material beyond because it is an extremely poor conductor of heat.

As soon, however, as a hose stream strikes the spot where this action has been going on, and especially if this stream has any considerable force, the concrete will crumble off to such a depth as has been seriously affected by the heat. This exposes new areas down within the material to the action of the heat, and if the fire be not immediately put out, or if the hose stream be temporarily withdrawn, the original action will be repeated, this time going so deep below the surface as probably to materially weaken the structure.

All of this shows why the provision of a thin coating of concrete over steel work, whether structural steel or reinforcing rods, is inadequate protection against a severe fire in highly combustible contents. It is obvious that a comparatively small fire in such contents would with the aid of a hose stream result in flaking off enough concrete probably to expose the steel members to softening and stretching, or in the case of structural steel to warping. In any such event the stability of the structure would be threatened, and would require careful examination to determine whether or not rebuilding would be necessary.

After the surface has thus been spalled off in the fire it is customary to repair it by a concrete wash or plaster. This merely fills in a space formerly occupied by the material which has disappeared, and it is very difficult to get a good bond between this and that portion of the original material which retains its strength. As a result a second fire would find the concrete a very easy victim, probably flaking off all of these repair spots or larger areas without the aid of a hose stream, and then going on deeper into the heart of the structure. It is thus obvious that where fire proofing considerations are of importance the concrete structure should be carefully designed with a view to making such a result as this impossible.

WIRE ROPE.

"Wire Rope" is the title of a valuable book issued by the Trenton Iron Co., of Trenton, N. J., containing a full list of the different kinds of rope manufactured, the fittings used in making fast wire rope, and full directions for the computation of rope transmissions with explanation of the apparatus used, the size of wheels allowable for different sizes of rope, methods of splicing wire rope, and other information which has been worked out and gathered by the engineer of the company, William Hewitt, in the course of a long experience. It is a substantial book, beautifully printed and well bound and is well worth possessing.

Patented Concrete Bridges

By Daniel B. Luten *

Engineering is the creative profession. Doctors and dentists make repairs; lawyers make dissensions; but engineers create the structures whereby humanity may apply to useful purposes the mechanical properties of matter. Doctors are busiest when we are sickest; lawyers are most industrious when we are most contentious; but engineers are most in demand when a community is most progressive in science and in art. For engineering is the art of applying science and the science of employing art. It is science applied and art made useful. The Constitution of the United States contains one clause, and only one, of specific encouragement to engineering as a profession, "The Congress shall have power to promote the progress of science and the useful arts." It is by this progress that the civilization of a community is measured. It is by the rate of this progress that the prosperity of the engineering profession is determined.

The profession is filled with noble minded men who have contributed their share towards the promotion of progress in science and the useful arts. It, unfortunately, contains a few who place their own necessities above the general good. For example, specialization in engineering enhances the welfare of the profession and of the public. Many an engineer has done poorly what a specialist would have done properly, and has thus injured the standing of the profession because of his shortsighted fear that his employers might think him incompetent.

Had he explained to his clients that engineering today was too broad to be contained in the head of any one man he would not only have increased their respect for his profession, but he would have helped to create a field for the specialist. Without such a field the specialist reverts to general practice and becomes his direct competitor.

Bridge engineering is perhaps the one branch of engineering in which more discord arises than in any other, because of failure to recognize the principle of the greatest good to the greatest number. There are bridge engineers who specialize in bridge design creating their field by superior salesmanship. There are bridge engineerse who create their demand by improvements in design, usually protected by patents. Competing with them are contracting engineers who design and erect. Also in active competition are a few state engineers who design free of charge. And more than all of these are the engineers in general practice, many of whom believe that they must pretend to be bridge engineers in order to retain their titles to civil engineering. As a consequence the prospective purchaser of a bridge is usually in a state of worried doubt or of deluded satisfaction.

Bridges are usually purchased by men lacking in technical skill, and are usually sold by men of superior technical skill. Hence there is the possibility that commercialism may induce the seller to take advantage of the buyer.

The same identical situation exists in the purchase and sale of an automobile. But bridges are most often bought by public officials who are rarely beyond the reach of criticism. Out of this situation grows a sort of warfare between professional and commercial engineers. A professional engineer is one employed by the buyer. A commercial engineer is one employed by the seller. The commercial engineer is a necessity in any manufacturing business based on technical skill. The professional engineer is a desirability when technical matters are involved. Neither can be eliminated without injury to the co munity.

The prospective purchaser of a bridge may today have his choice of wood, steel, stone or concret and patented concrete bridges. Covered wooden bridges are picturesque and more permanent than steel, but are not economical for heavy loads. Steel bridges are deservedly popular where lack of funds necessitates cheap and temporary construction. When long spans are essential they usually afford the only feasible solution. But no steel bridge can be considered a permanent investment.

Even the addition of a concrete floor to a steel bridge cannot lengthen its life materially beyond the usual twenty or thirty years. Concrete and stone bridges designed without patented improvements both represent permanent structures of the highest type, but usually at excessive cost as compared with steel and wood. Patented concrete bridges not only supply all the advantages of concrete and stone bridges, but in addition offer the benefits of the specific improvements patented, and at the same time enable the owner of the patents to maintain a specialty in which he can improve the design and efficiency of the structure. Hence it is usually the patented concrete bridge that competes in cost with steel bridges while retaining all the permanence of stone.

It must not be expected that the patented concrete bridge will contain as much material as its cruder stone or concrete competitor. But there is no more reason for selecting the latter on that score than for buying a locomotive in preference to an automobile simply because the locomotive contains more steel and perhaps costs more; if an automobile is desired a smaller sum will secure the better service. And if a highway bridge of given capacity is desired nothing is gained by buying a bridge with more material, and much may be lost, for the heavier bridge at less cost must necessarily contain inferior materials, or else some one has been deprived of profit at no benefit to the community. In nine cases out of ten the heavier, clumsier bridge will prove the weaker bridge.

The patented concrete bridge, to be an efficient competitor, must be improved in all its details, not simply in one feature. Patent protection therefore almost necessarily means numerous patents on many cost-saving devices, and the patents should be on improvements to the structure and not on some device accidentally applicable to the bridge.

Nothing perhaps has done more to throw opprobrium on patented concrete bridges than the practice popular in the past of patenting a knob, or a wrinkle on a steel bar and then making that an excuse for providing plans overloaded with such patented bars sold at a fancy price. Such designs have often been used to induce an unskilled contractor to take work at less than cost in order to provide a market for the patented bars. As showing the feeling of some of the profession towards this practice, the following quotation from Leffler's textbook on "The Elastic Arch" is of interest:

*Paper read before the American Society of Engineering Contractors, New York City.

Types of Concrete Bridges

Designed by Daniel B. Luten, Indianapolis

FAIR GROUNDS BRIDGE, DES MOINES, IOWA.

Span of Waterway, 12 Feet.

For the Iowa State Fair Association, Des Moines, Iowa, 1910.

PLATE VI.

Railway Bridge of Concrete.

Patented Concrete Bridges

Built According to the Luten Design

PLATE V.

Patented Concrete Bridge, Lima, Ohio.—Railway Loading. Twin Spans of 60 Feet Each. Contract Price, $6,600.

PLATE IV.

Patented Concrete Bridge, Plainfield, Ind.

Patented Concrete Bridges

Built According to the Luten Design

PLATE III.
Concrete Bridge, Plainfield, Ind.

PLATE I.
Concrete Bridge, Waterville, Ohio.

> "An engineer is a man of rigid honesty. He is too honest to allow a steel bar company to design his reinforced concrete work."

The definition is not sound, for conditions might exist where a plan prepared by a steel bar company would be the desirable plan, and an engineer who refused to use it under such conditions would hardly be honest with his clients.

Reinforcement having mechanical bond has played a considerable part in the development of reinforced concrete, and it is entitled to its share of the glory and the benefits. But the patented bar is merely an improved bar, and does not necessarily make an improved bridge, whereas numerous patents on improvements of the bridge itself do tend to an improved state of the art in bridge design.

The distinction is between those patents which earn their reward by an excessive charge for material and those for which a royalty is charged. Designs supplied free under the bar patents will rarely compete in cost with plans supplied for a royalty percentage; and the cost of the patented bars alone will invariably exceed the cost of non-patented reinforcement for a patented bridge together with a royalty of ten per cent of the contract price, the waste occuring in the excess of steel specified.

A patent is a contract between the United States Government and an individual, who himself makes an improvement. The patent rewards the individual, not for making the improvement, but for making the improvement public in such explicit terms that any skilled workman can duplicate the invention. The reward is seventeen years exclusive right to the improvement. No one else, without exception, may make, sell or use the patented device without the consent of the owner. No one may make such a device even for his own use. The reward is nicely proportioned to the value of the improvement, for if the improvement is worthless seventeen years of exclusive ownership will hardly prove of value, whereas if the improvement is valuable, the burden of proving its value rests with the patentee.

A patent is infringed by anyone who makes, sells, or uses the device covered by the claims of the patent. Thus a contractor infringes in building and in selling a patented bridge, a municipality infringes in using it. An engineer does not directly infringe in designing a patented device, but the courts have brought the engineer within the patent law by holding that the design and supervision of patented improvements without license are contributory infringements and punishable in the same way as actual infringements. This seems peculiarly appropriate, for the designer is more often the one that inspires the infringement than is the contractor. But where a contractor desires to avoid responsibility for infringement in bidding on plans prepared by another he can readily do so by stating in his bid that he will not be responsible for infringement of patents.

Considerable criticism has recently been directed at our statutes covering the granting of patents, but the criticisms apply to but a few specific abuses which can readily be corrected. The Progressive platform adopted at Chicago on August 7th contains the following commendable plank on this subject:

> "We pledge ourselves to the enactment of a Patent Law which will make it impossible for patents to be suppressed or used against the public welfare in the interests of injurious monopolies."

On the other hand, the owner of a patent is beset with many difficulties. Since a patent is a Federal grant, suits for injunction cannot be tried by a State court, but must be heard by a Federal court. An injunction may issue after the infringement is completed, on the theory that such infringement is a threat of further infringements in future. Unfortunately for the owner of the patent, such litigation may extend over several years and cost thousands of dollars before a decision is reached. In the suit of the Cameron Septic Tank Company vs. Town of Saratoga Springs, the costs are reported to have exceeded $50,000. And in Warren Brothers vs. City of Owosso for infringement of a pavement patent, the costs were upwards of $40,000. Patent litigation is, therefore, an expensive luxury for the contestant who loses the suit, but an absolute necessity for the owner of a patent who wishes to maintain the integrity of his rights.

Under our statutes, if, in a single instance it can be shown that the device patented had been reduced to successful practice prior to the alleged invention of the patent, it invalidates the patent. The absence of any such anticipation to any one claim of a patent gives the owner of that claim the exclusive use of every device that contains all of the elements recited by that claim. And the unauthorized use of any such device may result in an injunction to put a stop to its further use until an accounting may be had and the patentee's right to a royalty satisfied. In cases of flagrant infringement, a royalty of three times the established royalty may be collected.

Engineers very frequently object to the payment of royalty on patented engineering devices. This attitude is perhaps due to a generally prevalent feeling that the patented devices were well known long before the patent protection was granted. But even if this were true it would have no bearing on the validity of the patent. For the anticipation must be prior to the invention and not to the grant or even to the application. And if the anticipation be one of public use it must have occurred in this country and not in a foreign country. An engineer who bases his objection to a patent on the ground that it has been generally anticipated should at least fortify himself with one or two clearly authenticated cases of such anticipation before assuming invalidity for the patent. For such anticipations are sometimes more difficult to establish than is generally supposed.

Engineers sometimes object to payment of royalties on the ground that others, especially railroads, are enjoying the free use of the same devices. The most rational use of patents on engineering devices is to create a field for the expert. All that the expert can reasonably ask is the right to submit his work in competition with others. To do more than this results in creating enmity rather than business. It is reasonable, therefore, to permit any engineer to have free use of the patented devices so long as the owner of the patents is not himself opposed in competition by infringements of his own patents. Viewed in this light, such free use not only does not harm the patentee, but actually assists him by securing more rapid introduction of his devices. Under the statutes, failure to sue does not invalidate the patenee's claims.

Many engineers, and civil engineers paricularly, feel that the engineering profession is far above the necessity of a fostering patent system. They believe that an engineer who invents a new device should make it a present to the profession. Some believe that it is all in the engineer's daily work and does not amount to invention. Some feel that it is meritorious

to secure a patent and then dedicate it to the public without charge. They overlook the fact that invention under our statutes means not only the conception of a new device, but also its publication and its actual reduction to practice. To introduce a new device, whether patented or not, is much more difficult than to devise it. The inventor usually fails in business in attempting to introduce his hobby, although it may ultimately become extremely popular. The engineer who abandons his invention to the public, therefore, usually fails in his good intentions because the public does not learn of it. And he, at the same time, neglects one of the most powerful agents for enabling himself to specialize and thus further improve his product.

An engineer in government employ and who has developed his improvements at the public expense may well feel that he himself has no just title to the protection afforded by a patent. For under such conditions he could not maintain a legal title to any royalties for government work under such a patent.

The civil engineering profession is peculiarly in need of the benefits that accrue from patent protection. Most of the structures designed by civil engineers are built in place from designs made by professional engineers.

The engineering work coming to the average professional engineer is of very diversified character so that frequent reference to textbooks is necessary and the progress of the profession is therefore gauged largely by these publications. Yet even when protected by copyright there is but little profit in the publication of technical works. Hence our textbooks are apt to be written by theoretical men, teachers or professors with meager training in practice. Practical men are too busy to write and the actual writers are not practical. Our technical schools pay salaries so low that they can often employ only their own graduates as instructors, resulting in a process of inbreeding in instruction. And the profession is therefore left to drift under the leadership of impractical theorists.

Civil engineers are now making serious protest against the present rate of pay for their services. Patent protection is one of the strongest aids towards increasing such pay. Not only is a ten per cent royalty for engineering devices and services a good thing for the recipient, but it tends to raise the standard of engineering pay throughout the entire profession. The prime cause of low pay to engineers is the low standard of the work of civil engineers, and specialization and intensification is the remedy.

Many professional engineers are wholly lacking in commercial spirit. One practicing engineer gives as a reason for not having patented a cellular dam which he devised that he did not believe in building any subsequent dam in the same way. The commercial spirit did not appeal to him at all, and he would prefer to make a different solution for every dam. This is a commendable spirit of discovery, but not of specialization, so essential to the betterment of the profession in a financial way; the explorer enjoys new experiences, but the homesteader becomes the bank director. The engineer who thus idealizes engineering can rarely see any merit in a guarantee on an engineering structure. The guarantee is a matter of business rather than of engineering. The business man invariably recognizes the advantage of a guarantee because for him there is something more difficult even than engineering in the erection of any structure, that is, the selection of the properly qualified expert.

The highest efficiency in design of engineering structures is procurable only by competition of commercial engineers under the supervision of a professional engineer. The lowest efficiency usually results when the professional engineer designs his own structures, eliminating all competition in design. This is nicely illustrated in various water power projects, superintended by civil engineers, in which the mechanical and electrical installations are supplied by commercial engineers and are marvels of efficiency, while the structural features are designed by the civil engineering force in charge and are wonderfully crude. Steam railroads present another similar example. Their operating equipment is designed for efficiency, their bridges often for safety only. The operating department takes many chances, the bridge department takes none. The railway bridge engineer, burdened with the responsibility of his heavy traffic, is not to be blamed for placing safety first; but he often carries it to such extremes as to block the wheels of progress. The bridge engineer of an important railway made the statement in 1911 that he would never have used reinforced concrete for his bridges, but the vice-president of his road kept demanding it of him. Another prominent railroad engineer could not believe that concrete made by man could be as desirable for bridges as stone in the form that God had made. Ten years ago this view was by no means unusual in the civil engineering profession. Imagine the feeling of the mechanical engineering profession towards one of its members who would argue that steel was inferior to iron ore in the form that God had made!

That clause in our Constitution of encouragement to engineers reads in full as follows:

> "The Congress shall have power to promote the progress of science and useful arts, by securing for limited times to authors and inventors, the exclusive right to their respective writings and discoveries."

In a message to Congress in 1912, President Taft said:

> "The wisdom of the framers of the Constitution, in providing that Congress shall have power to pomote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their writings and discoveries has been demonstrated by the fact that industrial progress and development of the United States has been largely due to the stimulus to invention given by the protection afforded by the patent laws."

If this statement be true, may it not be possible that professional civil engineers, by assuming an attitude of hostility to commercial engineers and to patents on engineering structures, promoted necessarily by commercial engineers, have neglected and even opposed one of the most potent forces for the advancement of the profession?

Portland cement was invented in England and is manufactured and sold there as cheaply as elsewhere, yet England has been one of the slowest of the nations in the development of reinforced concrete, and of concrete bridges. France and Germany are ten years ahead of England; and she has been outstripped a good five years by the United States. A reason for this slow development is found in the attitude of the engineering profession. In England the professional engineer details his own plans and permits no competion except in labor and materials. The quantity surveyor is an English institution. He takes off the quantities of any proposed structure and supplies them

alike to all bidders. In France and Germany, on the other hand, competition in design is encouraged. The quantity surveyor is practically unknown and useless under such conditions. The English engineer maintains that competition in design results in much duplication of effort. The French engineer takes the broader view that it is not duplication but competition in effort.

Graft may seem more possible where choice of designs is permitted, but the possibility of graft is not eliminated by limitation to the single detailed plan, but is in reality only transferred to the engineer and the inspector. The greatest possibilities for graft exist in the single detailed plan on file awarded on unit prices, where the inspector may permit skimping of details and the engineer may allow swelled estimates. For the slow progress of the work enables the contractor to become thoroughly acquainted with the inspector and the engineer. Pooling of bids is encouraged when all bids are on the same identical thing with award to the lowest bidder, and with all bidders seeking their detailed information from the same source. No pool is probable when one bidder feels that he has a better chance than a competitor. Graft by an awarding official and pooling of bids are rarely co-incident, whereas the pooling of bids and grafting by the engineer are jointly possible when all bids are on the same detailed plan.

The profession of medicine deals with human life; the profession of law deals with human relations. The profession of engineering deals with inanimate matter and its usefulness to humanity. There is, therefore, no parallel possible concerning the desirability of competition in design and of patent protection. The professional relations that might apply in the saving of a human life would have no application in the building of a bridge. In a profession such as civil engineering, that to some extent encourages a sentiment against commercialism, at the same time that it can be benefited thereby, there is particular need for the protection afforded by patents to insure the development of new industries. It is the creative profession of civil engineering that requires some such stimulus to force it to do its share towards the advancement of progress in science and the useful arts.

REPAIRING CONCRETE SURFACES.

At the recent annual meeting of the American Railway Engineering Association, in Chicago, the Committee on Masonry reported as follows on the subject of repairing surfaces:

In all cases the surface to be repaired must first be thoroughly cleaned of all loose material, laitance and dust and the clean, rough, sound concrete exposed to receive the patch. Probably the best method of cleaning is by means of a steam jet.

After cleaning, the surface to be repaired must be thoroughly saturated with water, not simply moistened, but so thoroughly drenched that the old concrete will not absorb water from the new mortar or concrete used in patching. If possible, the surface should be kept covered with water for several hours.

If the repair of patch is to be made on a vertical or sloping surface and is not to be more than 1½ inches thick, the surface of the old concrete, while it is still wet, should be spattered or splashed with a cement grout, following this immediately with a fairly stiff plaster coat of mortar made of the same proportions of cement and sand as was used in the original concrete, but never richer than 1 cement to 2½ sand. This plaster coat should not be thicker than ½ inch, and each coat should be forced into the surface, but not dragged with a trowel. The surface of each coat, except the final coat, should be "scratched" to give a bond for the next coat. This plastering should preferably begin at the top and progress downward, and only enough time be allowed to permit each coat to receive its initial set before the next coat is applied. The final coat should be finished with a wooden float and only enough water used to properly finish the surface. This patch should be kept damp and protected from sun or frost till fully set up.

If the repair or patch or "finish coat" is to be made on a horizontal or nearly horizontal surface, the surface of the old concrete should be slushed and broomed with a thin cement grout, following this immediately with a wet mortar made of 1 part cement and 2½ parts sand or granite screenings and of the full thickness required (not less than ½ inch thick, however). When this mortar begins to take its initial set, it should be floated or troweled to such a finish as may be desired.

If the repair or patch is to be made on a vertical or sloping face and is to be more than 1½ inches thick, it will be advisable to imbed dowels into the old concrete, as deeply as the thickness of the proposed patch, and spaced sufficiently close together to firmly anchor the patch to the old concrete. The dowels must be wedged into the old concrete and it will be advisable to fasten wires, metal fabric or bars to the dowels, in the case of extensive patching, as an additional safeguard. The patching may then be done with mortar without forms, or with wet concrete supported by forms, depending upon the thickness and the extent of the patch.

If the repair or patch is to be made on a horizontal or nearly horizontal face and of considerable thickness, dowels may be used, or the concrete may simply be reinforced by fabric or bars without using dowels—treating the patch as a block of masonry.

Care must be taken not to have thin edges on patches. To avoid this, it may be necessary to cut out sound concrete around a place to be patched, so as to give deep edges to the patch. If possible, the edges should be undercut.

NEWS ITEMS.

That it is profitable to cement irrigation ditches is the statement of W. B. Wells of Plano, Calif., secretary of the Campbell-Moreland Ditch Company.

The Campbell-Moreland people now have nearly a mile and three-quarters of their ditch cemented and piped, with the result that they can let in twenty-five inches of water at the headgate and carry it over seven miles of ditch.

The ditch is cemented from the headgate at the Porter slough weir to the west side of Henderson orchard and from the Loma Linda pumping plant to a point 500 feet in on the Wilko Mentz land.

On the C. T. Brown ranch, east of Plano, there are 1,200 feet of piping. The fluming and piping are not continuous, being confined to those points where the land is especially sandy and the absorption consequently very great.

The Campbell-Moreland people are so pleased with their experience that they expect to cement more of their ditch from time to time.

Conveying Machinery Profitable

In general, contractors are alive to the importance of using labor-saving machinery, even on jobs which last but a short time. The saving in such cases is often considerable, but in contracts which extend over many months, the installation of labor-saving machinery is more important, and the economies correspondingly greater.

In the erection of the Atherton Avenue Bridge over the Pittsburgh Junction Railroad, Pittsburgh, Pennsylvania, the contractors (The Friday Contracting Company) decided that the installation of $1,000,00 worth of conveying machinery would be a profitable investment, particularly as the mixing plant was located on the hillside, some distance above the railroad tracks.

The machinery installed consisted of a Cement Bag Elevator, 49′ centres, having wheeled carriers attached

to a single strand of chain, a Continuous Bucket Elevator, 60′ centres, for sand and stone, and an Inclined Belt Conveyor 16″ wide, 180′ long, connected by chutes with both elevators, so that it could handle either bags or the sand and stone. The foot of the stone elevator is placed below the track level so that the material can be handled from drop-bottom cars, and the foot of the bag elevator is placed convenient to the door of a box car on the siding. A 10 h. p. motor placed near the head of the elevators, drives all three machines, the elevators being controlled by clutches so that either of them can be stopped while the other is elevating material.

The conveyor machinery for this entire outfit, which is shown in the picture, cost less than $900.00, and was erected by the purchaser's own men from drawings furnished by the Link-Belt Company of Philadelphia and Chicago, who designed and built the machinery. Approximately 8,900 yds. of sand and gravel and 48,000 sacks of cement have been handled by this outfit. In practice, one man was able to unload a car of gravel in about one hour and a car of sand in about two hours. The cement bag elevator was capable of handling about 13 bags per minute.

The growing tendency of the modern contractor is towards the use of labor-saving conveyor machinery —it not only cuts down the cost of handling, but reduces the number of laborers usually required on the job.

CEMENT IN EGYPT.

The Bulletin Commercial, of Brussels, states that Egypt now offers an important market for cement. In 1911 the imports were 106,670 tons, valued at $800,000, as compared with 87,503 tons in 1910. The great vogue for buildings of ferro-concrete has largely contributed to the remarkable development of the import trade in cement, and this trade seems quite likely to be maintained, in view of the attention which is being given by capitalists to the building industry. The extensive port works recently commenced at Port Said, and those projected at Alexandria, will necessitate the provision of large quantities of cement. The Belgian imports were the largest in 1911, amounting to 50,257 tons, followed by those from England, 35,192 tons. The remainder of the imports came from Austria, France and Germany. Artificial cement (slow hardening) is imported in barrels of 150, 180 and 200 kilos. gross for net. Sacks are taking the place of barrels, owing to the rapidity with which the cement is used. There are, however, cases where barrels are preferred. Natural cement (rapid or semi-slow hardening) is used principally by the natives and also for certain masonry work; it comes mainly from Belgium. This cement is imported in barrels of 140 to 150 kilos. gross for net, and in sacks of 45 to 50 kilos., sacks invoiced. The question of sacks sometimes presents difficulties for the importer. Empty sacks are invoiced to him by the manufactory; if he takes care of them, or returns them only in a bad condition, they are carried to his account. Cement users, however, do not readily agree to these conditions, and the importer eventually suffers the loss. English manufacturers are in the habit of shipping cement in very light bags, which are strong enough for one voyage and are not charged for. This method has given excellent results.

MEDUSA WHITE PORTLAND CEMENT.

A new catalogue has just been issued by the Sandusky Portland Cement Co. of Sandusky, Ohio, describing the various artistic uses to which their white Portland cement can effectively be put. The pamphlet contains dozens of illustrations of ornaments and buildings for which Medusa White Portland Cement has been used and is well worth sending for, as it will give many pointers to contractors interested in the artistic application of cement.

The Constitution of Portland Cement

A Paper Read Before the Ninth Annual Convention of the National Association of Cement Users

By P. H. Bates

The constitution of Portland cement is at least a matter of considerable interest if not of fundamental importance for its proper use. Notwithstanding the fact that this problem has been worked upon for a great number of years, yet it must be acknowledged that agreement among investigators is lacking to a great degree. The point of contention is whether the three essential ingredients—silica, alumina and lime—are present as a ternary compound (one containing three radicles) or as a binary compound (one containing two radicles). The adherents of the former theory consider that the silica, alumina and lime are combined to form a compound which is given as having a different composition by different investigators. This is the material to which the name "alite" is given. Those who support the idea of binary compounds alone; if they recognize the material "alite," hold that it is either tricalcium silicate or a solid solution of this silicate in tricalcium alluminate. The presence of the ortho-silicate (dicalcium silicate) as well as a dicalcium aluminate has been generally acknowledged. These, when more or less colored with iron, have been referred to as belite, celite or felite. It might be remarked that the optical data which has been given by many investigators regarding these latter is seldom sufficient to identify them, so that it frequently happens that the belite of one is not the belite of another. As the problem now stands, the question hinges upon whether the so-called alite contains alumina or is only tricalcium silicate. The possibility of there being a compound of the formula of $3CaO.SiO_2$ in Portland cement has been a matter of discussion for a great many years. In this country Newberry & Richardson have found present in the material which they made a compound which they claimed to have this formula, although this is contradictory to the results of nearly all foreign investigators with few exceptions, though among the latter was LeChatelier. The early work of the geophysical laboratory of the Carnegie Institution also pointed to its non-existence, but the last work of this laboratory, but comparatively recently published, acknowledged that there is a possibility of this compound being present in cement. However, they were not able to find it present in the materials made and examined by Newberry & Richardson. According to the recent work done by foreign investigators, Kaisermann has observed its presence, while Janecki denies not only its presence, but referring to the work of the geophysical laboratory, doubts the possibility of there being a binary compound under such conditions.

There has been installed at the Pittsburgh branch of the Bureau a 2x20-foot rotary cement kiln with the necessary grinding apparatus, for the study of Portland cement. It was recognized from the first that in order that the studies which were to be made might be complete, a petrographer with a complete outfit for petrographic studies must be installed. All burns would then be examined for their constitution according to the most approved and exacting methods. These notes therefore are a discussion of the qualitative constitution of the first burns made in this kiln.

It was thought advisable to publish some notes on the constitution of cement at present, in view of the fact that a complete discussion of all the work done would of necessity not be made until the results of the physical tests of the cement were available; as specimens were made up for two year periods, this would put off publication to a remote date. Also, there has not been developed a sufficiently accurate method to determine quantitatively the amounts of the various constituents present. There are several difficulties in the employment of thin sections of clinker in order to determine quantitatively the constituents. The first reason is the great difficulty to avoid overlapping grains. The sections, owing to the nature of the clinker, cannot be made less than .03 millimeter in thickness. The grains present in the clinker are usually smaller than this, consequently it happens in the section that one grain may be on top of another or may partly overlap another, thus destroying its distinguishing optical properties. It is also impossible to determine more than approximately the index of refraction of a constituent present in a section. This is one of the most important data which is necessary for recognizing individual constituents or crystals. The development of a method to secure accurate quantitative results promises to be a matter of some time.

In view of the greatly superior quality of the work of the geophysical laboratory with compounds made from pure materials, and of the accurate and detailed optical constants which they have determined for these, their methods, data, and results have been used by this laboratory as a standard. It must also be mentioned that burns made on pure materials in this laboratory have checked the results which they obtained. It has therefore been assumed from these results that commercial Portland cement may contain tri-calcium silicate, dicalcium silicate, calcium aluminates, in which the lime and alumina are combined in the ratios of either 3 to 1, 5 to 3, or 1 to 1, and free lime. Thus the presence of a low alumina ternary compound and a dicalcium aluminate is not recognized.

In the first series of burns made the alumina and iron oxide content has been kept approximately constant, while the silica and lime content have varied—from a low silica and high lime content to a high silica and low lime content. The limit in each case has been the limiting product which could be obtained in the rotary kiln. Thus a higher silica content would have produced a material which would have been in such a plastic state in the kiln that large balls of soft clinker would have formed as to so materially reduce the draft that proper combustion would have been prevented; lower temperature in this case would also have produced only dusting clinker. A higher lime content burn could not have been burned, since a sufficiently high temperature for such a burn could not be obtained at present.

The partial analysis of the burns is given below. The iron oxide and alumina are combined (the iron oxide averaging 3.50 per cent as well as the lime and magnesia the magnesia content averaging 1.70 per cent).

	14.	2A.	13.	15.	7.	10.	9.	11.
SiO_2	27.10	26.32	25.00	23.40	22.13	20.11	18.44	18.71
Al_2O_3 { Fe_2O_3 }	11.52	11.83	11.92	11.32	10.72	12.37	11.50	12.24
CaO { MgO }	59.84	61.36	62.29	64.32	66.35	67.29	67.69	68.65

The petrographic analysis are given i nthe following table:

Burn.	% $2CaO.SiO_2$.	% aluminates and $3CaO.SiO_2$.	% iron compounds.
14	66.0	11.1	22.2
2A	61.4	31.4	7.0
13	58.1	33.0	8.75
15	46.0	45.6	8.2
7	45.0	44.3	10.6
10	40.2	51.4	6.4
9	31.7	59.9	6.3
11	28.3	62.2	8.2

In the above table it is noticed that free CaO is usually present; but except in numbers 9 and 11, the pats made of these cements were perfect in both water and steam, even though the clinker was ground immediately after burning and the ground cement not further aged. The major constituents is the beta ortho-silicate. In two burns (Nos. 10 and 11) there was apparently some alpha ortho-silicate, but this was in but minute quantities, and may indeed have been the beta, as there is much difficulty in distinguishing between these two. As these examinations are of the clinker, no gamma ortho-silicate was found, since this is the form of the silicate which is produced when clinker dusts. Burns 14, 2-A and 13, however, did dust to a slight extent, and the gamma silicate was then present in the dust. The trisilicate was always present; in the low silica burns in but minute quantities, in the higher silica and higher burning temperature burns in much larger quantities.

Mono-calcium aluminate was found in one of the cements. In the two of the highest silica content, it is noticed that there were both the 5 to 3 and the 3 to 1 aluminate, in about equal quatities; but with increasing silica content the 5 to 3 aluminate decreases until in the burns containing under 20 per cent silica, it is absent. It should be borne in mind, however, that the question of temperature of burning enters into consideration here; the low silica burns were made at higher temperatures than the high silica ones, and with increasing temperatures, there is a tendency for the formation of increasing amounts of the 3 to 1 aluminate.

It has been found almost invariably that the iron oxide exists in three different forms. No matter whether the clinker be well-burned or under-burned, or whether it contains a high or low percentage of lime, the iron oxide always enters into the beta ortho-silicate. The grains of the latter are colored brownish to red. When the 5 to 3 lime aluminate is present, it also colors it, but it has not been noticed to color either the trisilicate or trialuminate. It also occurs in the interstices between the other cement minerals. In the case of low lime cements, this intestitial material is double refracting, has an index of refraction greater than 1.75, and seems to correspond optically to the compound $2CaO.Fe_2O_3$. With the very high lime content cements, and higher burned cements, this compound disappears and instead there is formed an almost opaque glass and a small amount of magnetite.

In general it is also noticed that those constituents are present as would be expected from the crystallization curve as outlined by Shepherd and Rankin. In no case was there observed a ternary compound of the composition $2CaO.Al_2O_3.SiO_2$. It might also be remarked that the tricalcium silicate which has been insisted upon by many foreign investigators as containing alumina, has been tested for this impurity by means of patent blue. This dye has been found in this laboratory to stain compounds containing alumina (previously noted by Kaisermann) and in no case has it been found that the compound called tricalcium silicate was stained. It therefore did not contain alumina.

It was mentioned above that burn 14 dusted. This dusting, however, was different from that usually obtained or noticed with cement clinker, in that it did not start within a very short time after leaving the kiln and also that the dusting was not immediately to an extremely fine powder. In this particular case in about two hours after the clinker dropped from the kiln and when it had fallen to about room temperature, some of it disintegrated into pieces about ½-inch in diameter. These pieces then broke up into still smaller ones, and this breaking up was continued until a fine powder was reached. Not all of the clinker dusted, however. On examination of these larger pieces at the end of several days, it was found that beta prime ortho-silicate was present. In the dust, however, it was absent and had apparently changed into the gamma ortho-silicate. This is the first case of which there is any record of the beta prime silicate changing into the gamma. The usual dusting of cement is the change of the alpha or beta into the gamma, but, as noted above, the mechanical operation of this change is different from the change of the beta prime into the gamma.

An approximate quantitative determination of the constituents in the clinker was made of a number of thin sections prepared from them. The method consists of observations with the highest magnification, using a Ramsden positive ocular and plate holder in which is inserted a double rectangular co-ordinate plate. This plate consists of two series of parallel lines at right angles to each other, the lines being equally spaced. This gives rise to a field made up of a series of squares. The constituents present in each square are estimated quantitatively, the unit being a square .01 mm. on a side. At least twenty fields are taken throughout the section and estimated, and the average represents the approximate quantitative composition. The ortho-silicate was estimated alone, the tri-silicate and aluminates together, and the iron compounds other than those coloring ortho-silicates, and are given in this manner in the table. As mentioned before, in thin sections it is extremely difficult to distinguish between the aluminates and tri-calcium silicates. For this series of burns there was found as follows:

Burn.	% $2CaO.SiO_2$	% aluminate and $3CaO.SiO_2$.	% iron compounds.
20	63.55	17.3	19.2
19	60.8	30.9	8.3
18	49.45	39.65	10.8
15	46.0	45.6	8.2
23	26.5	62.6	10.5
17	25.7	64.2	8.5

Owing to the lack of ability to distinguish between the tricalcium silicate and the aluminates, not much of value is obtained from the table. But it is noticeable that in a decrease of about 7.5 per cent silica, and an increase of about 9.5 per cent lime, there has been a decrease of approximately 38 per cent ortho-

silicate and an increase of approximately 50 per cent combined aluminate and tri-calcium silicate. As there was but little increase in the alumina content, it can be seen that there has been a very large increase in the tricalcium silicate content.

A second series of burns has been made in which the silica content has been kept constant, and the alumina-iron oxide and lime content varied. The partial analysis of the member of this burn are as follows:

	Burn 20.	19.	18.	15.	23.	17.
SiO_2						
Al_2O_3 }	23.42	23.97	24.11	23.40	23.69	23.57
Fe_2O_3 }	15.92	14.01	12.41	11.32	9.35	8.07
CaO }						
MgO }	60.66	60.89	62.89	64.32	66.95	68.25

This series shows about the same results as the first one. While free lime was noticed in all but one case, yet this was in very small quantities and in every case the pats, both in steam and boiling water, were satisfactory. The variation of the other constituents takes place in the same manner as before—with increasing lime content there is an increase in the amount of tri-calcium silicate and tri-calcium aluminate. In the case of the latter, this increase takes place, also, when the amount of alumina present decreases. However, in this latter case, the lime content has been increased and also the temperature of burning. Beta pime ortho-silicate was again noted in burn 20, which dusted in a manner similar to burn 14.

The quantitative petrograhic examination shows:

Burn. No.	Free CaO.	Beta $2CaO.SiO_2$.	$3CaO.SiO_2$.	$5CaO.3Al_2O_3$.	$3CaO.Al_2O_3$.	Iron oxide.
20.	None.	Major constituent.†	None.	Much.*	None.	Colors Beta ortho-silicate, 5:3 and 1:1 aluminate also as a ferrite, no Fe_3O_4.
19.	Very little.	Major constituent.	A little.	A little.	Much more than $5CaO.3Al_2O_3$.	Coloring ortho-silicate as a glass and Fe_3O_4.
18.	Very little.	Major constituent.	A little.	A little.	Much more than $5CaO.3Al_2O_3$.	Coloring ortho-silicate and as a glass —a little Fe_3O_4.
15.	Very little.	Major constituent.	More than above burns.	A little.	Much more than $5CaO.3Al_2O_3$.	Coloring ortho-silicate and as a glass and Fe_3O_4.
23.	Some.	Equal quantities.			Only aluminate present.	Coloring ortho-silicate as a glass and Fe_3O_4.
17.	Some.	Equal quantities.			Only aluminate present.	Coloring ortho-silicate, Fe_3O_4, and as a glass.

*Some $CaO.Al_2O_3$ present.
†Bi $2CaO.SiO_2$ present.

An approximate quantitative examination of thin sections of the clinker of this series, made in a similar manner as in the previous series, gave as follows:

PETROGRAPHIC EXAMINATION OF SOME BURNS OF SERIES I.

Burn. No.	Free CaO.	Beta $2CaO.SiO_2$.	$3CaO.SiO_2$.	$5CaO.3Al_2O_3$.	$3CaO.Al_2O_3$.	Iron oxide.
14.	None.	Major constituent.	A little.	More than the 3-1. Also some $CaO.Al_2O_3$ noted.	A little.	As Fe_3O_4, as a "ferrite" and coloring $2CaO.SiO_2$ and 5 to 3 alumina.
2A.	Very little.	Major constituent.	A little.	The aluminates are present in about equal quantities.		Coloring ortho-silicate and glass and 5 to 3 aluminate.
13.	Very little.	Major constituent.	A little.	A few grains.	Considerable.	Fe_3O_4 and coloring $2CaO.SiO_2$ and glass.
15.	Very little.	Major constituent.	More than above burns.	A little.	Considerable.	Fe_3O_4 and coloring $2CaO.SiO_2$ and glass.
7.	More than above burns.	Major constituent.	A few grains.	A little.	Considerable.	Fe_3O_4, "ferrite" and coloring $2CaO.SiO_2$.
10.	Very little.	Major constituent.	Considerable.		Only Aluminate.	"Ferrite" and coloring $2CaO.SiO_2$.
9.	Considerable.	Major constituent.	Considerable.		Only Aluminate.	Appears only as a "ferrite."
11.	Considerable.	Major constituent.	Considerable.		Only Aluminate.	Fe_3O_4, coloring $2CaO.SiO_2$ and a "ferrite."

The very large increase of the percentage of aluminate and tri-calcium silicate is here immediately apparent. By referring to the chemical analysis, it will be seen that burn 20 contains the greater amount of iron-alumina and least lime, whereas burn 17 contains the least iron-alumina and greater amount of lime. If all the alumina of burn 19 (actually present 9.49) were calculated to tri-calcium aluminate and this deducted from the total percentage of this aluminate and tri-calcium silicate as given above, there would remain 15.1 of the latter. (Note that in burn 20 no tri-calcium aluminate was present.) Making the same calculation in burn 17, where the alumina actually present is 5.78, we find that there is approximately present 54.7 per cent of tri-calcium silicate. While this amount of this latter silicate plus the amount of ortho-silicate found would require considerably more silica than was actually present in the clinker, yet there must be borne in mind the difficulties and inaccuracies in the quantitative petrographic examination of thin sections. The great increase in tri-silicate, however, remains clearly evident.

No attempt has been made at present to correlate this change in constitution with the physical properties of the finished cement. Such a discussion is reserved for a later period, when, as stated before, a more accurate method of quantitative examination will have been developed. Attention must be called especially to the fact stated before, that the changes noted above in constitution have been brought about not only by changes in composition but by changes in temperature also. In any case, that temperature was used which would give a clinker, the ground cement of which would satisfactorily pass the standard specifications. It was necessary of course to increase the temperature as the lime content was increased. A further study will consist of noting the change of constitution of burns made from various raw mixes as the temperature is changed. This is a matter of considerable time, as a number of burns and examinations will have to be made of each mix. Another study outlined is the accurate determination of all the iron compounds present. As noted above, the iron colors the ortho-silicate and 5:3 aluminate, but does not otherwise materially change the optical properties of these.

DEVELOPMENTS IN CEMENT MANUFACTURE—WHITE CEMENT.

By E. B. Scott.

It is difficult to realize how large a place cement occupies today in all our ideas of construction and how rapid this development has been. So accustomed have we become to concrete construction that we no longer look for it to represent something else, but accept it for itself. Everyone now realizes how horrible are the cement blocks shaped in imitation of ashlar-cut stone or concrete walls marked off into rectangles to represent granite block construction.

While concrete has thus made its own place among materials of construction, and no longer needs to be used as an imitation of something else in one regard it leaves something to be desired from an artistic standpoint, and that is the matter of color.

The natural color of concrete in spite of the fact that we have become accustomed to it, is not pleasing. Its tone is decidedly cold and harsh. In various ways architects have sought to get around this difficulty and a variety of paints and washes have been resorted to. It is not easy, however, to secure any degree of durability in this way, so the attention of chemists and cement manufacturers has been turned more and more to the problem of making a cement free from this defect, or as far as possible clear white.

As a matter of analysis all the elements that compose a standard Portland cement can be obtained in a perfectly white state and there is no reason why a Portland cement the equal in all respects of the ordinary gray cement should not be made from them. In practice this proved to be somewhat difficult and costly owing to the care required in the selection and treatment of the component materials, which had to be assembled from widely separated regions. Several foreign and Eastern companies succeeded in solving the problem, however, and when their products were put on the market they were welcomed, for they made possible splendid decorative work in concrete which before had not been attempted.

The cost of making white cement was of course considerably higher than that of ordinary gray cement, but its advantages were so manifest for a number of uses that it soon had a large market throughout the Eastern states. Among its important applications were the facing of concrete buildings, mortar of laying face bricks and tile, interior decoration, bathrooms, terazzo work and so forth, as well as for pergolas, statuary, and ornamental work generally.

The use of white cement on the Pacific Coast has been very limited. The Eastern price was reasonable enough, but when over $2.00 per barrel was added for freight charges, white cement became too much of a luxury for everyday use. Meanwhile, however, a careful reconnaissance was made throughout California in search of materials out of which to make white cement, and this painstaking search was crowned with success. So it now appears that we have right here on the Coast the necessary ingredients to make a cement that stands all the tests of a standard Portland cement and is as white and stainless as any of the Eastern brands. This result has been brought about by the Santa Cruz Portland Cement Co., at their Davenport mill, and great credit is due them for their enterprise in accomplishing it, as it will have an important bearing on the Pacific Coast architecture.—The Achitect and Builder.

HOW TO PATCH A CONCRETE FLOOR.

When a cement floor surface begins to wear it is often desirable to patch it. Leonard C. Wason, in a recent paper states the right way and the wrong way.

The Wrong Way. Commonly a sand and cement mortar is made, some cutting is done and the mortar is put in and scrubbed with a steel trowel until smooth. It is then covered up for awhile. If the concrete under the patch is left dry it soaks up the water of the mortar. As a result, the mortar does not set. If the room is dry or hot the surface of the patch dries out and for the same reason it does not set. If the concrete under the patch is dusty the patch does not adhere to the concrete. If the materials in the mortar are not suitable, naturally the patch wears badly, particularly as it is obviously located at a point of severe wear.

The Right Way. Cut down the worn place at least one and a half inches. This cutting should be carried into the strong unbroken concrete and the edges should be cleanly undercut. The bottom of the cut should then be swept out, clean-blown out with compressed air or a pair of bellows, if available, then thoroughly wet and scrubbed with a broom. In this way, small loose particles of broken material which the chisel has driven into the surface are removed. A grout made of pure cement and water about the consistency of thin cream, should be scrubbed into the pores with a broom or brush, both at the bottom and sides of the cut. Following this a stiffer grout, about the consistency of soft putty, should be thoroughly compressed and worked into the surface, which has already been spread with grout. Finally, before the grout is set a mortar made of one part cement to one part crushed stone or gravel, consisting of graded sizes from one-half inch down to the smallest, excluding dust, should be thoroughly mixed and put in place, then floated to a proper surface. Cover with wet bagging, wet sand, sawdust, or other available material. All trucking should be kept off and the surface kept thoroughly wet for at least one week or ten days.

If a particularly hard surface is required, 6-penny nails are sometimes mixed with the mortar and other nails stuck into the surface when the patch is finished. This will produce a surface which is extremely hard and durable.

TWO TRAINLOADS OF CEMENT ARE SHIPPED FROM MASON CITY EVERY DAY IN THE YEAR.

The Northwestern States Portland Cement officers and directors concluded their annual meeting at Mason City, Iowa. The reports were in the nature of a revelation even to the directors when it was announced that the output of the mill during the past year had been 14,000 car loads, or putting it in more understandable terms, a train load of about forty cars per day. Within half a mile of the Northwestern States is the Lehigh Portland cement plant with about the same capacity.

The Ship Canal Cement Works, with a capacity of over a thousand barrels a day, are about to be opened at Ellesmere Port, England. The company is an English one with only English capital, but the process selected is American.

Gravel and Sand Washing Plant.

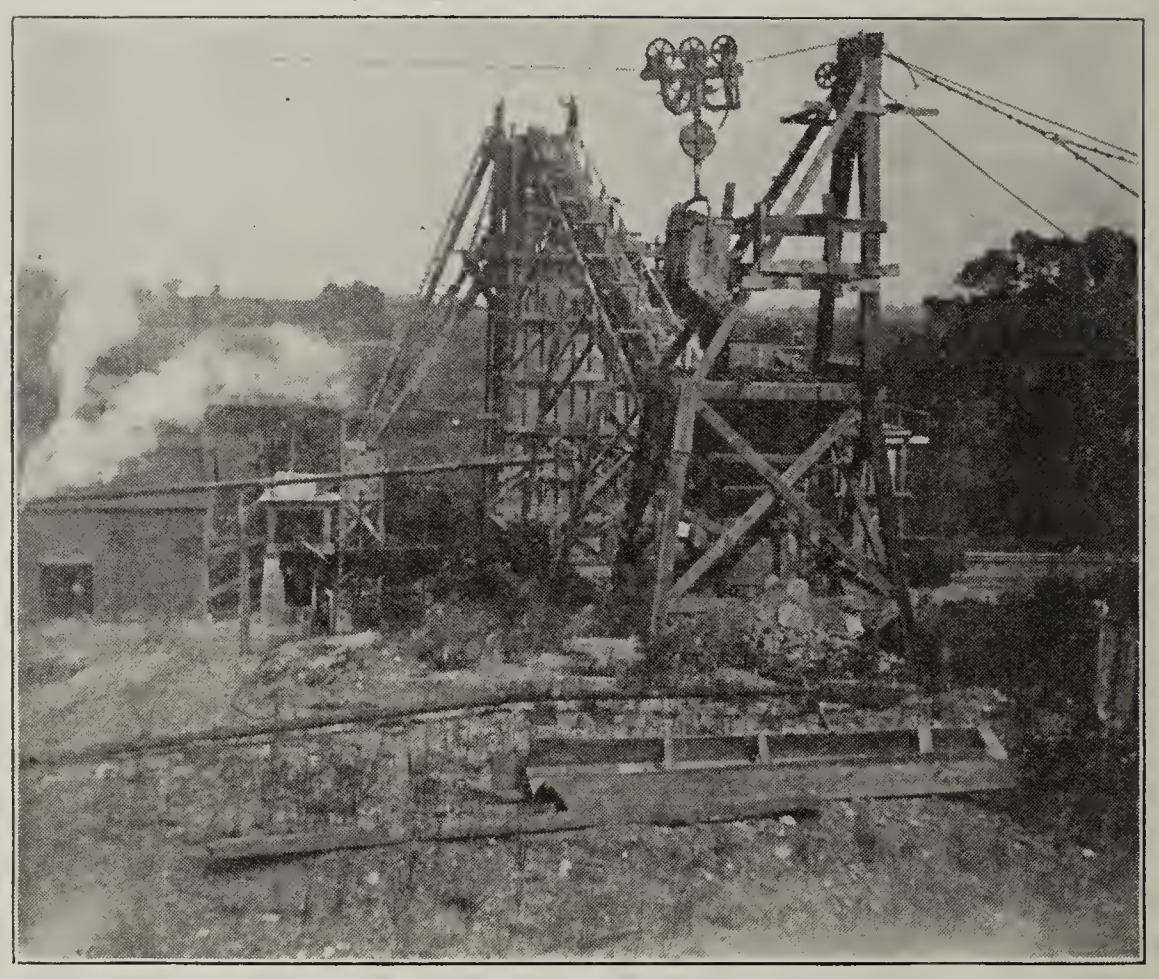
The Kickapoo Sand & Gravel Company of Attica, Indiana, operates a modern gravel washing plant which possesses some unusual and interesting features. The plant is located on the Chicago & Eastern Illinois Railroad, four miles north of Attica, near the famous Kickapoo Falls.

The arrangement of the washing screens and bins is similar to that used on all plants of this character with the details carefully adapted to the local conditions. The manner of bringing the gravel from the pit and elevating it to the screen hopper is shown in the illustrations. Gravel is excavated by a 2¼ ton shovel, suspended from large cables passing over the pit. This shovel is operated by a 50 horse-power Lidgerwood hoisting engine which brings it to the plant and automatically dumps into a large receiving hopper. This hopper delivers the gravel onto a 24-inch inclined belt conveyor, 120 feet long between centers which elevates the material to a hopper at the top of the building. Here it meets a large flow of water which washes it into and through the screens. The large stones from the first screen are rejected to a No. 4 Austin gyratory crusher from which the crushed stone is again elevated to the hopper at the top of the plant and passed a second time into the screens. The rejections from the two succeeding screens are passed into the bins below, No. 8 or 1¼-inch crushed gravel for concrete work from the second screen, and No. 5 or 7-16-inch gravel for roofing. The fines from the third screen are discharged into a settling tank which separates the No. 2 or washed torpedo sand for cement work and the rejections here are passed into a second settling tank which further separates all the fine No. 1 sand for plastering and brick-laying.

The hydraulic stripping of the clay is a most interesting feature of the operation here. The four to six feet of clay covering the gravel bed is washed away by a stream of water carrying two hundred gallons per minute at a very low cost per cubic yard. The arrangement of the pumps and valves allows the water from the stripping pump to be diverted to the screens, if for any reason there is trouble with the washing plant pump.

Excavation is being made at the present time from the water from an 80-foot bank.

The water for washing and hydraulic stripping is pumped from an 8-inch drive well, 68 feet deep; two Dean Bros. duplex steam pumps, located at the bottom of the concrete dry well, 10 feet diameter, 33 feet deep, deliver to the screens at the rate of about 1,000 gallons pr minute and to the stripping nozzle at 200 gallons per minute. The power house is of brick and steel. The power for the entire plant is generated in two 80 horse-power boilers and the crusher, washing and conveying machinery is driven by an Erie Automatic Engine of 120 horse-power. A Rope Transmission System drives a countershaft at the top of the plant from which power is distributed to the elevator, conveyor and screens. The crusher is driven direct from the large engine and the hoisting engine which operates the excavator bucket is located in an adjacent building.



SHOWING METHOD OF DELIVERING MATERIAL TO THE PLANT.
Shovel Dumping Gravel in Hopper, Kickapoo Sand & Gravel Co., Attica, Ind.

NEW CRUSHER CATALOG.

Gyratory Crushers and other rock handling equipment, covering a wide range of application are described in Catalog 27, issued by the Austin Manufacturing Co., of Chicago, Ill. In addition to crushers the list includes screens, elevators, cars and bins. Brief descriptions of detailed parts are given, together with sizes and prices. Considerable space is devoted to designs of crushing plants for different purposes with detailed plans showing the plant layouts. This data is supplemented by foundation dimensions and illustrative diagrams applicable to different sizes of equipment. The treatment in the text is brief and to the point and the accompanying illustrations are well chosen and of excellent quality.

SAND AND GRAVEL NEWS.

With all of the building and street improvement that has been going on in Salem, Oregon, during the past few years, the Salem Construction Company has been actively identified with a large part of it, as they supply the sand, gravel and crushed rock for a good many of the new large buildings, as well as a good part of all other improving that has been done. Their office is at 464 Court street, under the management of P. L. Frazier and E. C. Minton. Their material is well liked by all contractors, as it has a reputation of being clean and free from all dirt.

Their bunkers are at the foot of Belmont street at the mouth of North Mill creek. This company was the first to depart from the old way of loading gravel on the wagons with a shovel and install a modern and up-to-date bunker, where all that is necessary for the teamster is to drive under the spout and pull a slide. This company has been engaged in this kind of business for the past three years, and Mr. Frazier says that every year has shown a substantial increase of business over the previous one, and the prospects are for 1913 to far out-class anything that they have done so far.

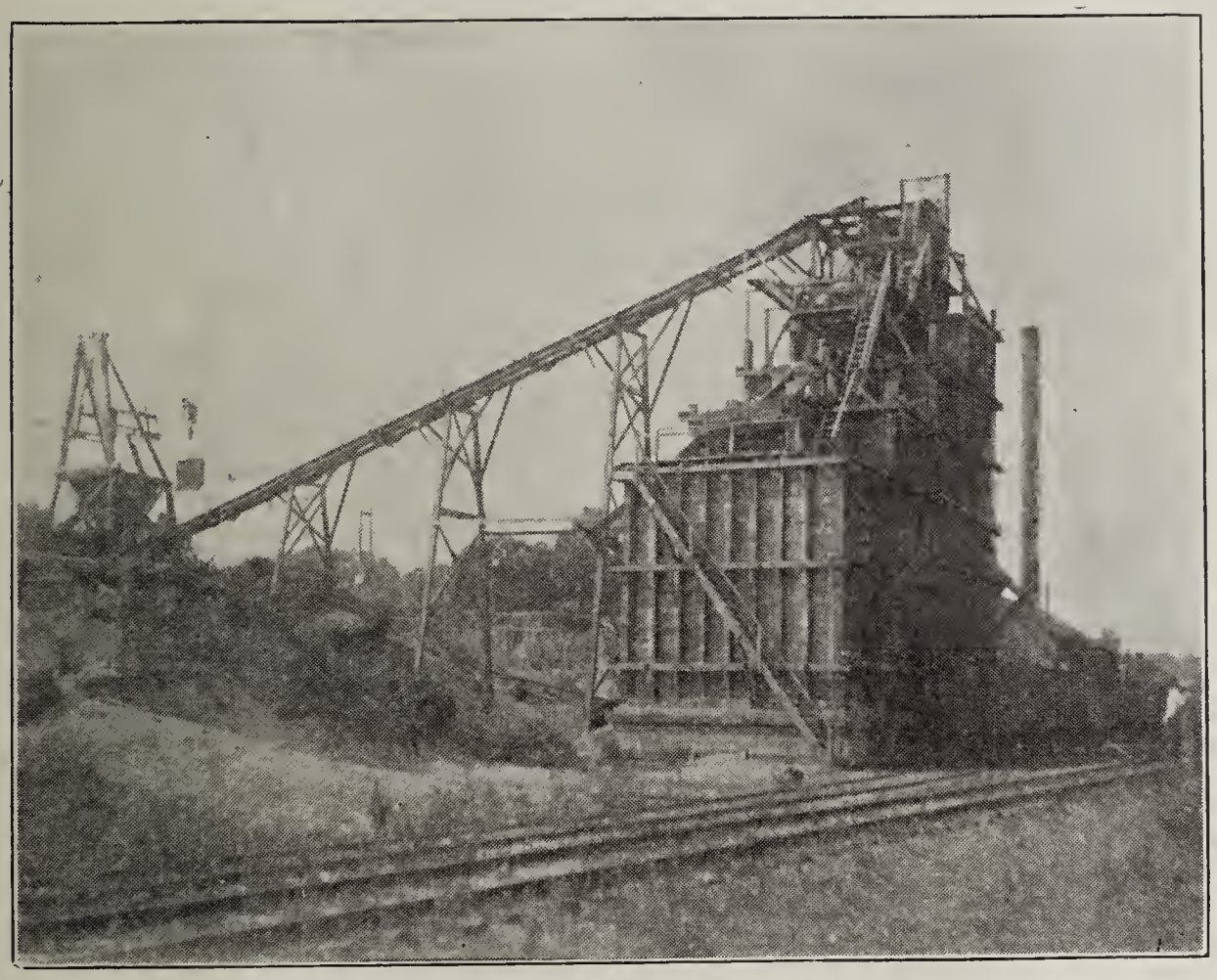
The increased business which the Ohio Sand Company, of Conneaut, Ohio, has been handling during the past years and the orders booked ahead for the coming year has necessitated some marked changes in the personnel of the company.

Floyd Lyons has resigned his position with The Pittsburg Steamship Company and has gone with the sand company, assuming the position of manager of production.

The position he will assume with the Conneaut concern is newly created by F. E. Gordon, president of the Ohio Sand Company, and is in keeping with plans of that official to better facilitate the handling of moulding sands at the plants of the company and to accomplish better loading and shipping advantages.

The manager of production will take over some of the duties heretofore performed by Mr. Gordon himself, and by the superintendent of the company, R. A. Hood. The installation and operation of all machinery will be in his charge. However, none of the present employes are relieved and no other changes will be made.

Classifications in freight rates for sand and gravel shipments are demanded in resolutions adopted at the second annual meeting of the Association of Sand and Gravel Producers of the United States at the Auditorium Hotel last week in Chicago. A two-days' session was held. "During the year 1912," said Frank Renwick, of Chicago, president of the organization, "the sand producers of the country, members of this association, did a business of $30,000,000 in freight rates and other transportation charges. The enormous sum is due to the fact that we have no classified freight rate and can be charged whatever prices the transportations companies feel like charging." The meeting was held in conjunction with the cement show at the Coliseum.



GRAVEL WASHING PLANT OF THE KICKAPOO SAND & GRAVEL CO., SHOWING BELT FROM HOPPER.

NEW SAND AND GRAVEL COMPANY.

Concrete contractors in Indiana will be interested in the announcement of the organization and equipment for active operation of the Lake Cicotte Sand & Gravel Co., at Logansport, Ind., of which Mr. H. E. Blasingham is president and manager. The company is prepared to furnish screened and washed sand and gravel in all marketable sizes for concrete work; also molding sand, and sand suitable for pavement cushions.

Systematizing Form Work

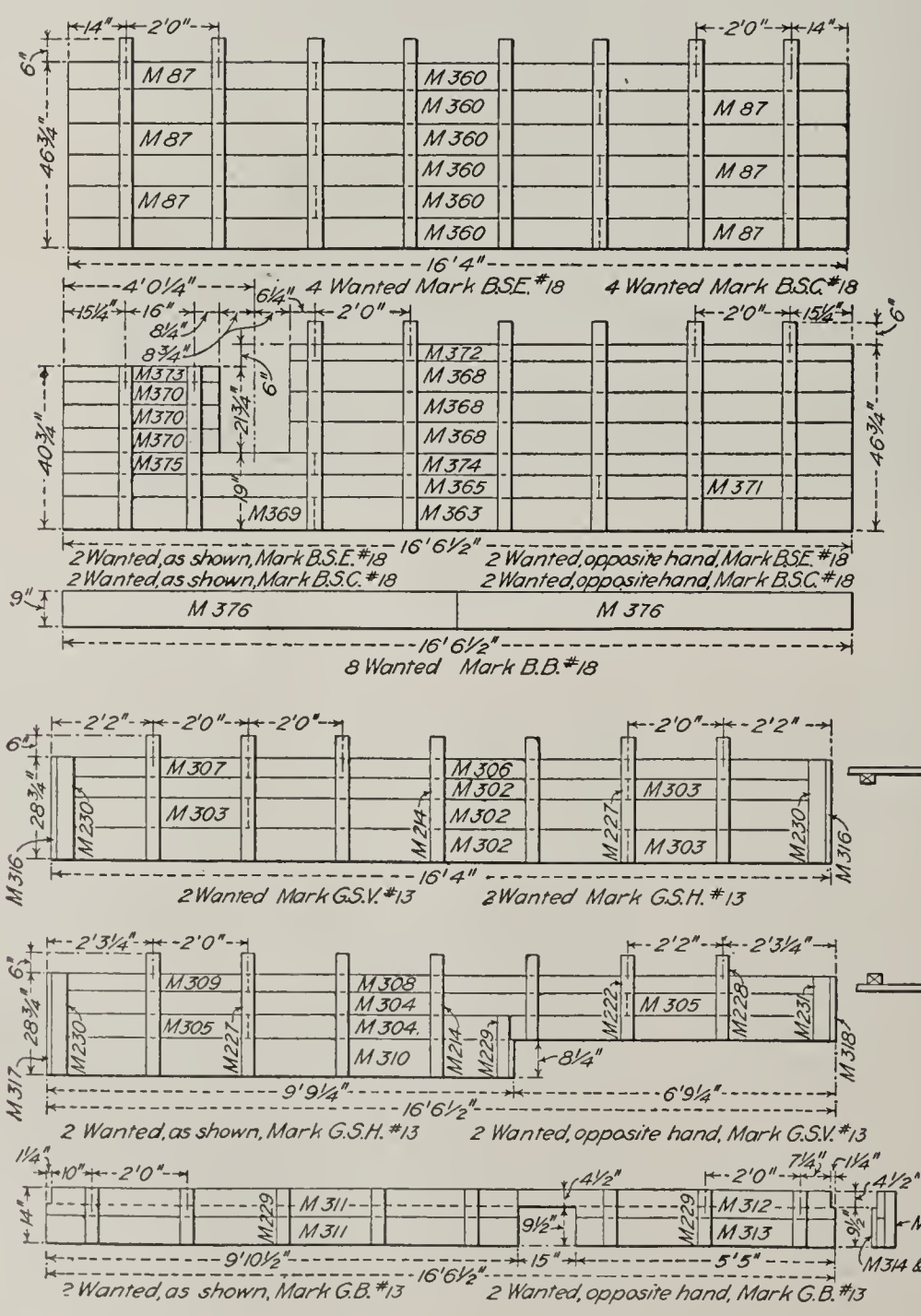
Reinforced concrete contractors recognize that the cost of form work is one of the dominant factors in determining whether a given job is executed at a profit or a loss. During the last few years a number of construction companies have been investigating methods of form work with an endeavor to devise some system whereby the cost could be reduced. One of the most successful efforts in this direction has been that of the Aberthaw Construction Co., Boston, who by detailing the forms in the drafting room of their home office and by a careful routing of the material have reduced the cost of their form work 20 per cent in the last three years. Those who have been in contact with this work have called it "scientific management," but Leonard C. Wason, President of the Aberthaw Construction Co., prefers to call it "systematizing," and very aptly puts it: "We pay thinking men to think, and carpenters to saw boards."

Perhaps the very best way to illustrate their system is to consider the question of form work at the ten-story Larkin Terminal at Buffalo, N. Y. This building was erected by the Aberthaw Construction Co., while the consulting engineers were Lockwood, Greene & Co. of Boston. The total quantity of form lumber used was nearly 1,000,000 board feet. In order to understand that which follows it should be noted that this structure is 580 ft. long by 109 ft. wide, the floor space being over fourteen acres, and is bounded by Van Rensselaer, Carrol, Exchange, and Hydraulic Streets.

First of all, at the home office of the Aberthaw Construction Co., a location plan of all beams was made. In this, similar beams were given identical numbers irrespective of location in the building itself. From this location plan form drawings in detail were made, a detail drawing being required for each different sized form, both for sides and bottoms and the beams of different varieties of column forms were also detailed.

The system of lettering used on this work is of particular note. In order to show the exact location of each form in the building, letters were suffixed to the beam numbers. For instance, a form marked BSE18 would mean that it was for the beam side of beam No. 18 on Exchange Street. The bottom form for this same beam would have the symbol BBE18.

An additional number had to be added to the symbol in the case of the column forms, as there is a variation in the height of the floors. The figures prefixed to the ordinary column symbol designated that the particular form was for the second story columns. To illustrate, a column form with symbol 2CSE19 would mean second story form column side Exchange Street, while 19 is the number of column proper as specified by the original location plan.



Lumber Schedule 1st & 2nd Stories			
Wall Beam #18			
No. Pcs.	Size	Length	Mark
48	1¼"x7¾"	11'2"	M360
48	1¼"x7¾"	5'2"	M87
24	1¼"x7¾"	11'9½"	M368
8	1¼"x7¾"	11'3¼"	M363
8	1¼"x7¾"	5'3¼"	M369
24	1¼"x5¾"	3'3½"	M370
8	1¼"x5¾"	11'3¼"	M365
8	1¼"x5¾"	5'3¼"	M371
8	1¼"x4½"	11'9½"	M372
8	1¼"x4½"	3'3½"	M373
8	1¼"x5½"	11'3¼"	M374
8	1¼"x5½"	5'3¼"	M375
16	1¾"x9"	8'3¼"	M376
80	2"x3"	4'4¾"	M239
16	2"x3"	3'4¾"	M240
32	2"x4"	4'4¾"	M241

Lumber Schedule 1st & 2nd Stories			
Wall Beam #13			
No. Pcs.	Size	Length	Mark
12	1¼"x7¾"	12'2"	M302
12	1¼"x7¾"	4'2"	M303
8	1¼"x7¾"	12'3¼"	M304
8	1¼"x7¾"	4'3¼"	M305
4	1¼"x5½"	12'2"	M306
4	1¼"x5½"	4'2"	M307
4	1¼"x5"	12'3¼"	M308
4	1¼"x5"	4'3¼"	M309
4	1¼"x8¼"	9'9¼"	M310
8	1¾"x7"	9'10½"	M311
4	1¾"x7"	6'8"	M312
4	1¾"x7"	5'5"	M313
4	⅞"x9½"	9'10½"	M314
4	⅞"x9½"	5'5"	M315
8	1¼"x4¼"	2'4¾"	M316
4	1¼"x3¾"	2'4¾"	M317
4	1¼"x3¾"	1'8½"	M318
32	2"x3"	2'10¾"	M214
8	2"x3"	2'2½"	M228
36	2"x3"	1'2"	M229
12	3"x4"	2'4¾"	M230
4	3"x4"	1'8½"	M231
12	2"x4"	2'10¾"	M227
4	2"x4"	2'2½"	M222

Form details were designed complete for two stories and to each form detail was given a symbol to be stenciled on this form when made up, together with the number or quantity required in the first two stories of the structure. On this same form detail the width of the form was divided into an exact number of boards which were to make up this total width of the dimensions written on the drawing. Therefore, having given the exact length of form and the width of the different boards going to make up this form and the total number of forms required for the job, it is quite readily seen how the sum total of boards with the exact dimension was easily summed up.

Aside from these form details, it was, of course, necessary to draw plans showing assembling of forms, the chief object of this being to specify the spacing of posts and jacks, amount of bracing, and location. From this assembly plan, together with a layout plan of the building, the exact number of pieces and size of lumber constituting the centering could be scheduled. On this completed schedule bids were obtained from the various lumber dealers before ordering the material for the job.

It was very vital that a systematic plan of piling and laying out the lumber should be adopted, inasmuch as 1,000,000 board feet were used. Particular attention was given the dressed stock going to make up the forms proper since this was taken to and from the mill to the benches. The lumber was so piled that when the laborer wanted a certain number of boards of a particular size he could find them quickly, for a plan was drawn showing the lumber layout and the relative location of different piles of lumber according to widths and lengths. Signs were placed in front of each individual pile, stating the dimensions.

On the Larkin job the Aberthaw Company found it best to build two distinct saw mills, since 90 per cent of the dressed stock had to be cut to exact length. Both mills had practically identical equipment, but were laid out slightly different. The most used piece of machinery in these mills was a cut-off saw on either side of which was a table where the stock was placed before being cut. The other equipment consisted of a rip-saw, boring machine, planer, and emery wheel.

To illustrate the methods employed in making up a complete form from the blueprint as received from the Aberthaw Construction Co.'s Boston office it may be desirable to follow in detail a single operation.

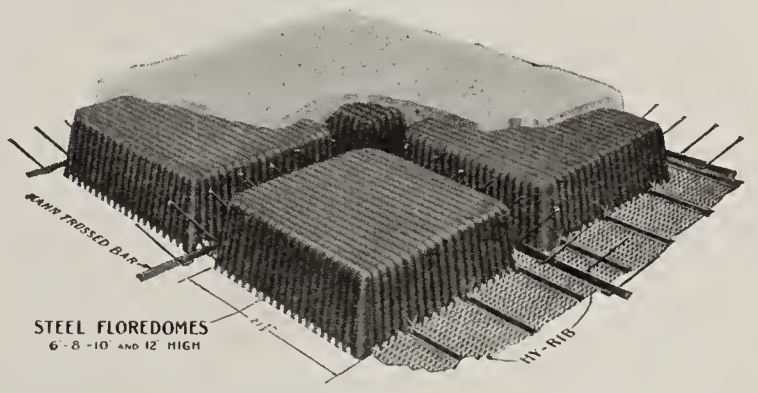
The form details, as previously mentioned, stated exactly the boards which would constitute a particular form and the number of forms required. Cards were made out at the route clerk's office stating for the labor foreman the number of pieces of stock and sizes to be taken to one of the mills. The mill men in return received orders from the route clerk stating the length to cut off the stock and, if ripping was required, to what width to rip. It was the duty of the labor foreman to tag this stock according to the number indicated on his order card. When all the stock required for a certain form had been cut and delivered to the proper bench, orders were issued by the route clerk to the two carpenters, who worked at the same bench, to make the number of forms required as indicated on the blueprint.

In order that the forms were made up in time to erect as planned by the office, eight benches were used with two carpenters at each bench. The carpenter having been given his orders by the route clerk telling him what lumber would be tagged to make up a certain specific form and having been given blueprint of the same form, he merely laid his stock on the bench and nailed it together. When the forms were completed a laborer oiled the same and stenciled them according to the symbols printed on the forms by the carpenters. If not required for immediate use the forms were piled systematically back of the bench at which they were made. When needed, teams carried the forms to that part of the building for which they were designed. Since it was previously determined at which point of the building the erection was to be started, a clerk was given the duty of listing forms as required for erection, and seeing that labor foreman received orders to have these forms delivered to the exact part of the building where and when needed.

A SYSTEM OF TWO-WAY STEEL FLOREDOME REINFORCED CONCRETE CONSTRUCTION.

Floredomes are rectangular, dome-shaped steel tiles with only the bottom side open. They are manufactured by a process of cold pressing from rolled steel plates. The deep corrugations are said to impart exceptional stiffness to the Floredomes, so as to support the trucking loads coming on them during construction. They are also designed to provide a bond between the domes and the concrete and serve as an additional reinforcement for the latter.

Floredome construction, in combination with reinforced concrete joists, would seem to offer a type of construction for floors and roofs well worth considering. The Floredomes take the place of the concrete, where it is not effective in resisting stresses and thus greatly reduce the dead weight of the construction



without appreciably sacrificing strength. The result is claimed to be a material saving in beams, columns and footings.

The reinforced concrete joists extend on all four sides of the Floredomes and carry the loads in two directions to the support. The concrete is thus stressed in two directions, with the idea of gaining the greatest possible economy in material. The joists are deep and narrow, so as to require the minimum amount of concrete and steel.

The great depth of a floor built with Floredomes is said to give the construction increased strength and rigidity.

Floredomes are very light in weight and large in size, as compared with other materials used similarly. The amount of floor laid by the average working man is, it is claimed, at least doubled and the cost of field labor is thus greatly reduced. The Floredomes are of one piece, and are watertight. For this reason, there is no possibility of loss of concrete between joints. The light weight of the Floredomes would seem to offer a saving in freight, shipping and hauling charges. They are slightly tapered, so that they can readily be nested to obtain a full carload shipment.

As the Floredomes are made of steel, there can be no loss due to breakage in handling and shipping.

A flat ceiling design without any projecting beams or girders is obtained where Floredomes are used. The reinforced concrete girders, extending around the four sides of the panel between columns, are built flush with the bottom of the concrete joists. The Hy-Rib used for ceilings extends continuously over the entire ceiling and sets into the special notches provided for it in the bottom of the Floredomes. The plaster is applied directly to the under side of the Hy-Rib.

In factory or warehouse construction, where flat ceilings are not necessary, the Hy-Rib on the under side of the Floredomes may be omitted, the Floredomes remaining permanently in place. The construction in this form is said to be extremely economical. The saving in centering, where Floredome construction is used, would appear to be a considerable item, as only the simplest type of flat falsework is required.

Floredomes are made in various sizes and weights.

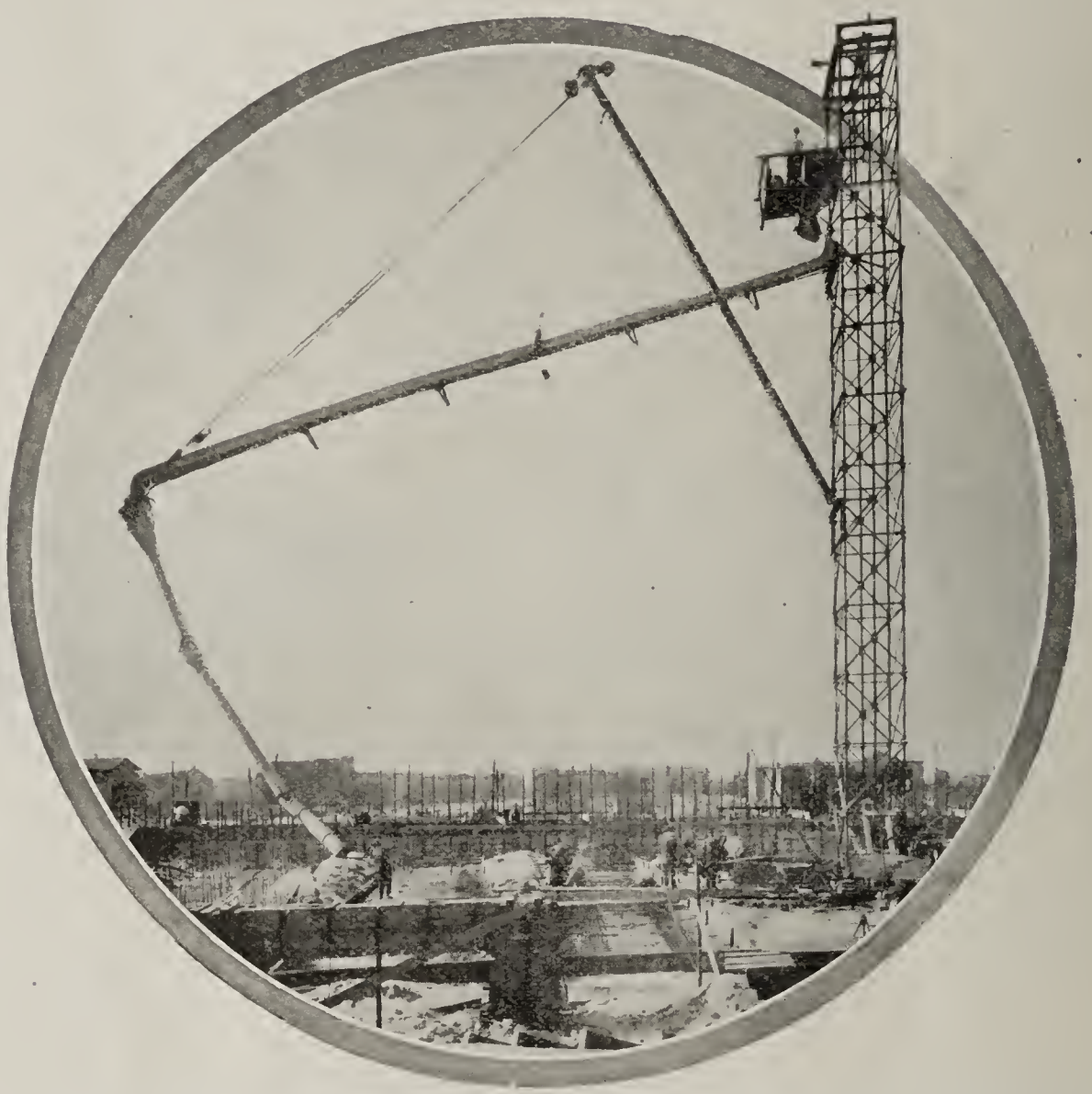
This novel type of floor construction was devised by and the materials used in it are manufactured by Trussed Concrete Steel Co., Detroit, Michigan.

Co., was consulted and he suggested a steel tower and from this developed the portable steel tower which has been found to be most satisfactory and economical, as the total cost set in place was less than $1,000.00.

Considerable ingenuity had to be exercised in the design of this tower to make it portable and flexible so that concrete could be placed in any part of the range of its spout which is 60 ft. long, with an additional loose vertical spout 30 ft. long. This enables placing concrete 95 ft. away from base of tower.

The horizontal spouting is made of heavy galvanized iron 10″x10″, open at the top, and is set on a light frame steel truss. The steel truss and spouts are all supported by a 40 ft. boom which is rigged from top of tower and held in place by steel blocks and cable running to a winch. The winch is secured to side of tower so that the boom spout and loose leg may be raised or lowered or swung in a semi-circle, giving a wide range of work and placing concrete anywhere within a radius of 95 ft.

The steel tower is 72 ft. high made up of 6 ft. sec-



PORTABLE STEEL TOWER FOR PLACING CONCRETE IN BUILDING THE NEW ROUNDHOUSE FOR THE LAKE SHORE RAILROAD.

CONCRETE ROUNDHOUSE.

Considerable interest is being taken in the method adopted by the Ford & Phillips Co. for placing concrete at the Englewood Roundhouse for the Lake Shore & Michigan Southern Railroad at Chicago, Ill.

The chief difficulty in this particular job is the fact that concrete has to be distributed over such large area, the roundhouse being 405 ft. in diameter. Also the pit walls are so high above grade that distributing by wheel barrows is impossible and the cost of a series of wooden towers is found to be prohibitive, three towers costing nearly $2,200.00.

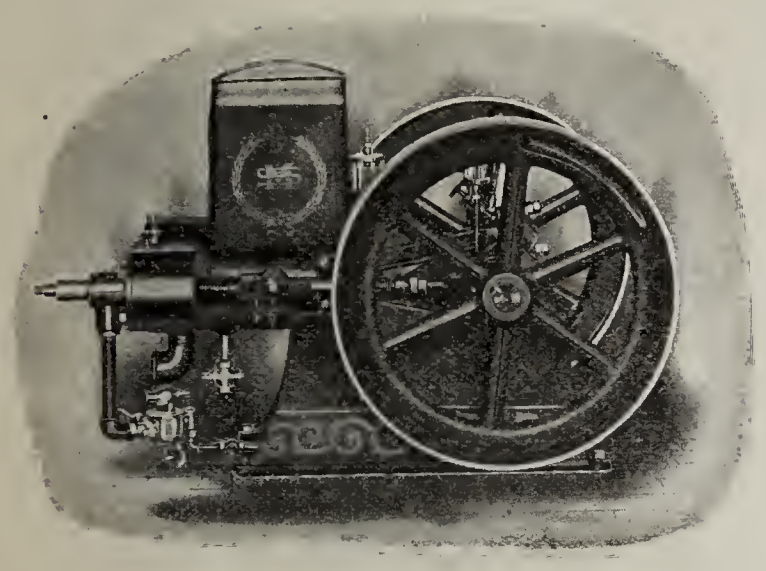
W. B. Louer, Chicago representative of Chain Belt

tions, sections being composed of steel angles and channels. The tower rests on heavy wooden skids that have steel liners, which rest on railroad rails, making the whole rigging easy to move.

After the concrete has been placed in one section the tower is drawn back along the rails by means of the hoisting engine of the tower. This operation is accomplished by loosening the guy wires and a change of 60 ft. can be made in about four hours time. Then they are ready to distribute again. This feature alone is worth many times what the tower costs, as it would be out of the question to accomplish this with wooden towers. Up to the date the Ford & Phillips Co. have moved the tower six times.

The concrete is mixed by a concrete mixer which is situated about 600 ft. away from the tower on account of having the mixer near the storage bins which are on a railroad siding. The mixer discharges into cars which are conveyed to the tower, and the concrete is dumped in the bucket of the elevator and hoisted to the top of the tower where it is automatically dumped into the receiving hopper. This receiving hopper has a gate which is operated by a man standing on a platform at the top, and he regulates the flow of the concrete through the spouts.

Twelve men are used in this plant, including those that load the loose material in the mixer, engineers connected with the mixer and hoisting engine, and those that spread the finished concrete. A ½ yard mixer is used, and an average of 18 to 20-cubic yards per hour or 150 cubic yards to a day of eight hours is being turned out.



THE CASTLE AUTOMATIC GASOLINE ENGINE.

The general principle on which gasoline engines operate is practically the same in all makes, but the question of service and efficiency, the maximum results with the minimum cost, is another matter.

The Castle gasoline engine, illustrated herewith, manufactured by the A. M. Castle Engineering Company, La Crosse, Wis., embodies a number of features that make it, the manufacturers claim, one of the most economically operated of any in its class.

Fuel consumption, the makers claim, has been reduced to the very lowest possible point, as it is impossible to waste a charge of fuel, an explosion being required to open the exhaust valve. Except at this time the cylinder is entirely closed and the charge is compressed and re-expanded therein back of the piston. More power and greater efficiency are obtained from the fuel on account of its being taken into the heated cylinder and churned before ignition, and also due to the fact that no power is wasted in driving gears, tumbling rods, ratchet wheels and other complicated mechanism, such as will be found on the ordinary engine. Every one of these engines is fitted with a float feed carburetor, as in a high grade automobile, which adds much to the simplicity and reliability of this little engine.

The governor used is of the hit and miss electric type and is so arranged that it absolutely regulates the speed of the engine, and also saves the battery by cutting it out on idle strokes.

The jump spark system of ignition is used with this engine. This is conceded to be the most satisfactory system for high speed engines and is so arranged that the spark can be accurately timed. This device for advancing the spark, or retarding it for easy starting, is one of the distinctive features of the engine.

The high top cooling tank placed on these engines is one of their best features, as it does away with all separate water tanks, pipe connections, etc.

It requires only about four buckets of water for an ordinary day's run. The small tank is easily and quickly drained in cold weather and easily refilled when starting, thus practically preventing any freezing and bursting of jackets.

The Castle engines are built in sizes from 4 to 12 h. p. and are guaranteed not only to fully meet requirements, but as to workmanship and dependability.

The company have just issued a descriptive pamphlet that can be had on request.

NEWS ITEMS.

Nealis & Tomasso, contractors on the Oakland & Antioch Railroad in California, are using a steam shovel of the Marion type, 15 Koppel double-side dump cars and Koppel portable track. Murray & Homer, contractors on the same line, are also using a Marion shovel and Koppel cars.

NORTHWESTERN ELECTS.

At the annual meeting of the Northwestern States Portland Cement Company, held at Mason City, Iowa, the following officers and directors were chosen:

President—Charles H. McNider, Mason City.

Vice-President—E. J. Breen, Fort Dodge.

The former assistant western sales manager, Mr. H. M. Scott, is now western sales manager. The former advertising manager, Mr. S. B. Chittenden, Jr., is now assistant western sales manager.

Mr. W. A. Davis is eastern advertising manager, with headquarters at Allentown, Pa., and Mr. J. B. Mackenzie is western advertising manager.

Treasurer—F. E. Keeler, Mason City.

Secretary—F. G. Ray, Vinton.

Assistant Secretary—R. E. Boyle, Mason City.

Directors—Charles H. McNider, Mason City; E. J. Breen, Fort Dodge; F. E. Keeler, Mason City; M. J. Scanlon, Minneapolis; T. H. Dinsmore, New York City; M. T. Gunderson, Kenyon, Minn.; W. T. Johnston, Toledo, Ia.; A. F. Frudden, Dubuque; F. G. Ray, Vinton.

The only change in the list of officers and directors was the election of Mr. Ray, who fills the vacancy caused by a death during the year.

A substantial gain was made during the year over former years. The output was about 14,000 car loads.

CHANGE IN ORGANIZATION.

Several changes have recently taken place in the organization of the Lehigh Portland Cement Company.

The former western sales manager, Mr. F. E. Paulson, is now general traffic manager. Mr. W. F. Clark will be his assistant, with headquarters at Allentown, Pa.

"THE STEAM TRIP."

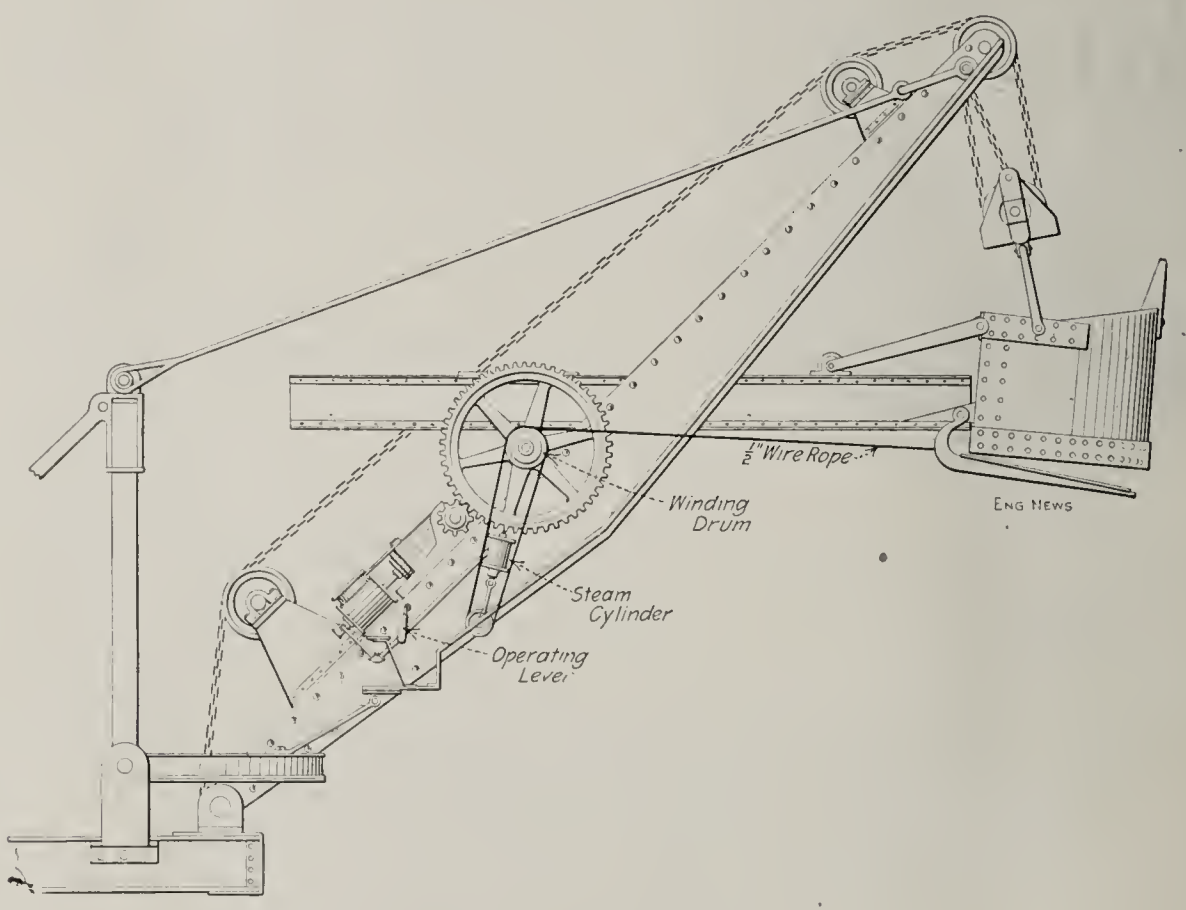
The necessity for an improvement on the hand-pulled latch, commonly used on steam shovels and many dredges, has long been evident, especially for the larger sized dippers. We illustrate below a steam-operated device for pulling the dipper latch, which should appeal strongly to owners and operators of steam shovels and dredges. While bringing to the operators welcome relief from the heart-breaking effort of tugging and pulling at a sticking dipper latch, the shovel output is very materially increased. On account of the rapidity and certainty of the dumping operation, the operators waste no time getting the dipper dumped and back immediately into the work.

The device, as may be seen from the illustration, consists of a grooved drum of the same diameter as the rack pinion, which is fastened to the end of the shipper shaft and revolves with it. A steam cylinder or ram, carrying an idler sheave on its pushout rod, is bolted to side of boom below the engine. The drum carries an idler sheaves, a half-inch flexible wire rope from the dipper latch passes over this sheave, over ram sheave, and is then wrapped around the grooved drum, and rope-end anchored thereto. As the dipper stick runs in and out, the rope is wound on or off drum at same speed, so as to maintain the same degree of tautness at all times. To dump the dipper, a three-way cock located beside cranesman is opened, admitting steam to run, pushing out idler sheave, thus pulling rope and tripping the latch instantly. After this operation, the ram is relieved, and returns automatically. The exhaust steam from the ram is piped inside the boom members and away from the cranesman's field of vision. For shovels up to 5-yard dippers, a 6x8 inch ram cylinder is used. This size ram gives a pull of 2,800 pounds, approximately, which, together with the long stroke, obviates entirely the "hair trigger" adjustment of the latch levers necessary when the old style of hand-pulled latch is relied upon.

This steam trip is the result of six years' development in latch tripping devices on the Panama Canal work. After extensive tests on the 95-ton shovels, it was adopted in December, 1911, as the service standard for the 100 steam shovels owned and operated by the Isthmian Canal Commission.

The Panama Canal shovels are worked about as hard as any in the world—it is a government job, and they have unlimited capital to invest in cars and motive power to serve the shovel to its limit. Recently, two operators on the Panama Canal broke the world's record with shovel 257, excavating and loading 5,554 yards from the Gatun borrow-pit in an eight-hour working day. Shovel 257 carries a 5-yard dipper and is equipped with the steam trip.

The Steam Trip is manufactured and sold by the Lines Flynn Company.



A GRAVITY YARD FOR A BALLAST CRUSHING PLANT.

A gravity yard has been built at Piedra, Cal., in connection with a new ballast-rock quarry for the Atchison, Topeka & Santa Fe Coast Lines, which operates in such a way that no locomotive power is required after pushing the cars on empty-storage tracks until loaded cars are made up in the loaded-storage yard. It is located on Kings River, the terminus of the Kings River Railway, a branch built primarily for this service. It is about 17 miles north of Reedley, or about 40 miles east of Fresno by railroad, in the foothills of the Sierras. The road up to the quarries has been built with a maximum grade of 1 per cent and a maximum curvature of 12 deg.

The quarries and yard are located on the south bank of Kings River, the quarry floor being about 40 ft. above the river and the quarry face rising 100 ft. from the floor. The quarry face is about 1,500 ft. in length.

A high-line track for empty cars leads off the main line a short distance south of Piedra station and rises on a 3-per cent grade to the empty-car storage. From this storage yard, tracks run down on a switchback past the bunkers of a rock-crushing plant and thence to the low-level yard for storage of loaded cars. The latter yard again connects with the main line on an easy upgrade near the Kings River station. The arrangement is clearly shown in the accompanying plan and profile.

A storage capacity of 60 cars is provided in the high-line yard, while the low-line yard has a capacity of 100 cars between the bunkers and the limit of gravity. Bottom-dump Rodger ballast cars are used, each car having its 40-yd. load line marked by means of a telegraph wire fastened around the sides at the proper distance from the top by means of staples. This eliminates the keeping track of yardages.

Cars are started on the high line by pinch bars, two being run down at a time. Spring switches are thrown in passing from the high line to the low line at the end of the switchback, and the cars are stopped and started in the opposite direction by gravity on a stub-end incline just beyond. At the bunkers they are stopped by brakes and loaded by means of gates in the bottom of the bins. They are then started again, usually by releasing the brakes or by a pinch bar. They proceed by gravity to the desired point in the loaded-car storage yard, the first cars in a string running 1900 ft. until brought to a stop by an adverse grade. This grade eliminates the possibility of cars getting away.

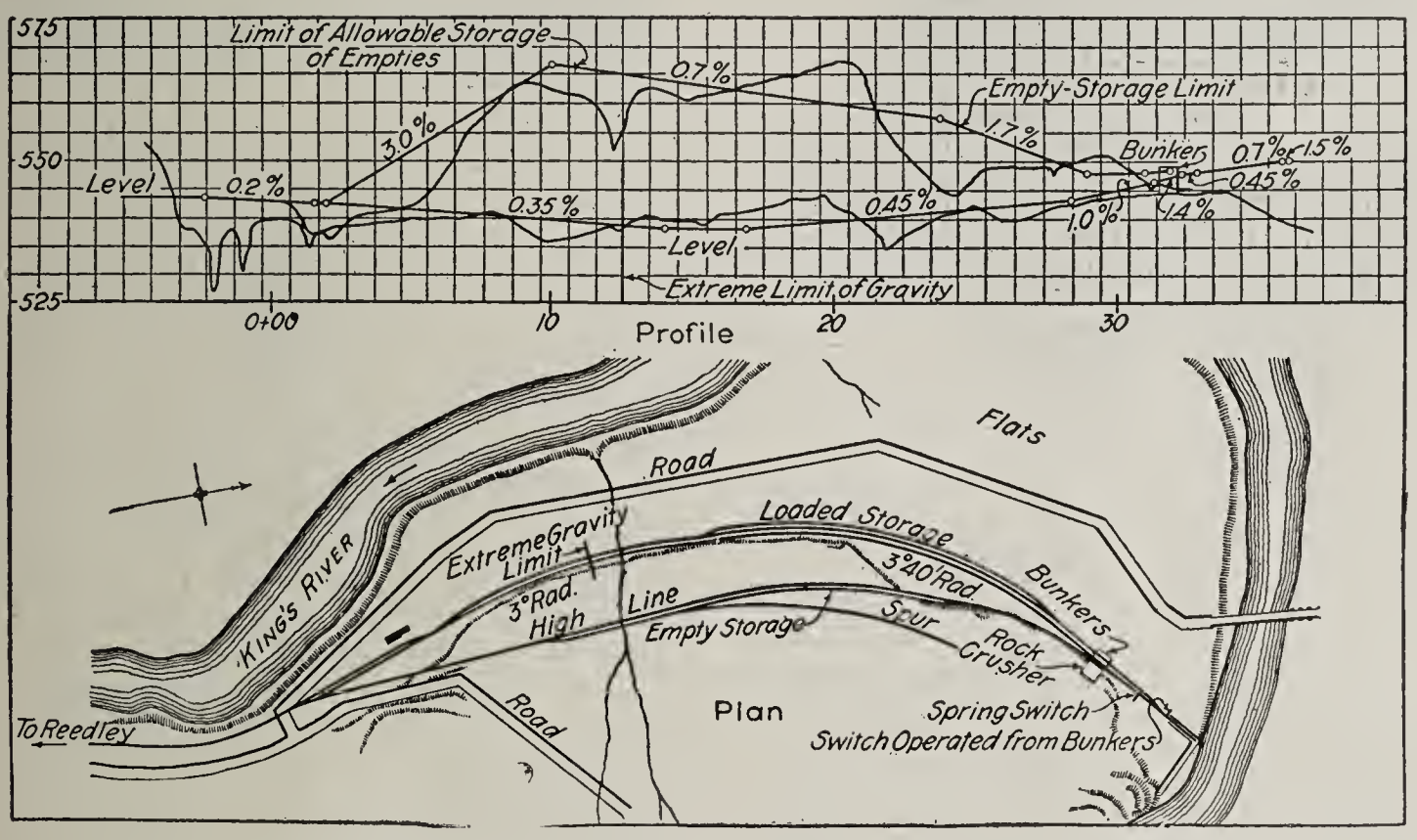
The gradients adopted in this yard were carefully worked out so that each performs its particular function. Standard formulas for rail and curve resistance were employed and the results were verified to a certain extent by tests, cars being dropped over existing grades and the velocities noted. The curve-resistance coefficient used was 0.01 less than the Santa Fe standard, which is 0.05. The chief difficulty was found to be the provision of sufficient curve and rail resistance to make the cars operate satisfactorily without giving them so great momentum as to render the working dangerous. The tail track beyond the spring switch was made of sufficient length to handle the cars with little or no braking, and the 0.45-per cent grade in the loaded-car yard is such that the drawheads are not endangered.

In the operation of the yard it has been found that the average of the loaded cars run up the adverse grade on the low line to the distance which was computed in the design. On account of the rusty tracks and rough rails during the first months of operation, it was not deemed advisable to raise the tail track to its final grade. The results proved the correctness of this precaution, but after a few months' operation, when the rails were smooth, the tail track was given a final raise to bring it to profile grade. In order to make cars respond well and to take the switches more easily, they were jacked up and the ball bearings of the trucks were oiled so as to remove any rust accumulations.

The Rock-Crushing Plant.

The rock-crushing plant has a capacity of 2,000 cu. yd. per day, or 2,500 cu. yd. when feeding directly to the smaller crushers. Under ordinary conditions it is run at 1,600 cu. yd., or 40 carloads of 40 yd. each. The storage bunkers have a capacity of 2,000 cu. yd.

The rock crushers are located at the foot of the quarry hill on a gravel flat bordering the river. The plant contains one No. 10 Gates crusher, two No. 6 and one No. 4. Screens are provided to eliminate sizes above 1¾ in. and below ⅜ in. In the operation of the quarry, 5-yd. dump cars are used, loaded at the face by steam shovels and hauled to the crushers by small camel-back engines. They are dumped directly into the hoppers of the No. 10 crusher, from which the rock passes to the No. 6 crushers and thence through screens to the bunkers where rock too large to pass through the final screen is automatically returned to the No. 4 crusher and again to the bunkers. In case it is desired to increase the capacity of the plant, auxiliary hoppers are opened, which allow the quarry cars to dump directly into the No. 6 crushers on the deck below their tracks.



PLAN AND PROFILE OF THE GRAVITY YARD AT PIEDRA, CALIF.

In the construction of the gravity yard every possible advantage was taken of the natural features of the ground to reduce the cost to a minimum. The opportunity for doing so was chiefly afforded in the construction of the high line along a bench about 20 to 25 ft. above the gravel flats, the low-level yard being laid out on the flats at the foot of the slope.

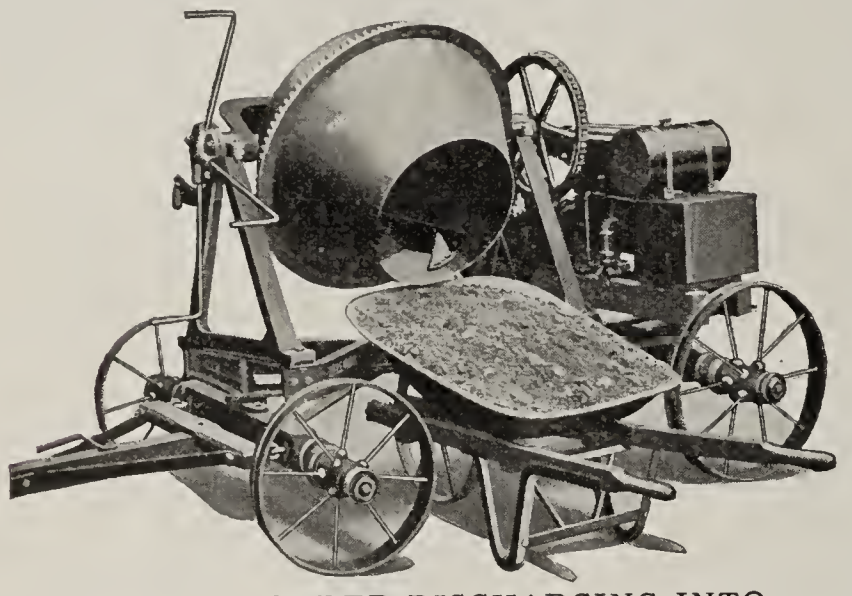
The Piedra gravity yard and ballast plant were built by the Sharp & Fellows Contracting Company under the direction of Mr. C. A. Morse, chief engineer of the Atchison, Topeka & Santa Fe System and Mr. H. C. Phillips, chief engineer of the Santa Fe Coast Lines. Mr. W. L. Bradley is division engineer in charge at Fresno, Cal. The plant is being operated by the contracting company.

The Little Wonder Concrete Mixer

"The Small Job Money Maker"

There is no longer any question as to the utility of the power concrete mixer on even the smallest jobs. Hand mixing, in view of the remarkable pace set by the Little Wonder Concrete Mixer, is positively a losing operation for the contractor.

The appearance of this machine about a year ago from the shops of the Waterloo Cement Machinery Corporation, Waterloo, Iowa, aroused great interest because of its extreme simplicity, and this feature stamped it as the climax of mechanical genius in concrete mixers. A tilting drum of peculiar shape, in which there are no movable parts whatever, is the only mechanism aside from the 2½ horse power gasoline engine, and at first glance it seems preposterous



LITTLE WONDER DISCHARGING INTO WHEELBARROW.

to expect much from it. Today, however, the Little Wonder will be found at work in every state in the Union in large numbers, and the enthusiasm of its purchasers is something unique in the annals of concrete machinery. Anyone who reads "Recent Remarks"—a collection of some of the latest testimonials received by the manufacturers, will readily perceive the spontaneous nature of these "Remarks."

The Little Wonder combines large capacity with light weight and easy portability. Its closely coupled trucks allow truning in narrow places. It is readily installed in basements or on upper floors of buildings. It can be used to great advantage at points where the amount of concrete to be mixed does not justify setting up a large machine. The Little Wonder charges from the material pile on one side and discharges direct into barrows or forms on the other, and is of great utility even on large engineering projects when the heavier work is done and only the lighter work remains, such as drives, walks, floors, etc. The range of adaptability of this mixer is one of the secrets of its wide popularity. The capacity of the mixer is three to four cubic feet per minute, or 25 to 35 cubic yards per day.

As the quickest, surest way of bringing the new principles employed in the Little Wonder to the knowledge of contractors, the manufacturers are placing the machine unreservedly in their hands for ten days' trial on their own work. This affords a practical test of the mixer under personal control and the decision is left entirely with the contractor, with no expense—not even the freight, in case the machine is not sastisfactory to him in every respect. When it is considered that in less than twenty days the Little Wonder will pay for itself in the profit over hand mixing, it will be seen that this "Man to Man" proposition is of great significance. Also, it requires no great amount of foresight to perceive that the earliest in the field with this machine will reap the greatest benefit.

LITTLE WONDER CONCRETE MIXER ON FOUNDATION WORK DISCHARGING DIRECT INTO FORMS.

NEW B. C. CEMENT PLANT

British Columbia Portland Cement Company, East Princeton, B. C., has practically completed its plant and will begin the manufacture of Portland cement this spring. The home office of the company is at Vancouver, about 150 miles west of the works.

The plant is on the Canadian branch of the Great Northern, and the southern branch of the Canadian Pacific is building into East Princeton. Transportation facilities thus furnished will enable the company to secure competing rates and make shipments to all parts of the Greater Northwest.

The buildings are constructed entirely of stone taken from the company's own quarries, and the lime for mortar is also being burned on the ground. These two commodities, stone and lime, will continue to be a part of the output of the company, as also vitrified clay brick, which is now being manufactured and which has been used for setting up the boilers, etc.

This company has a rather unique combination of raw materials on the spot, the limestone being about 600 feet away from the crushing end of the factory building, the shale about 900 feet and the coal about 1,500 feet.

The main factory is 60x434 feet; stockhouse, 60x200 feet; engine and boiler room, 60x118 feet; coal drying house, 35x65 feet.

The immediate equipment includes one 80x125 foot kiln, although the ultimate equipment will be three such kilns. Sufficient crushing and grinding machinery for a second kiln is already being installed. The kilns are from the Bonnot Company, Canton, Ohio. The rest of the equipment includes No. 6 Gyratory Crusher, made in Milwaukee; dryers and coolers made in Owen Sound, Ont.; Emerick pulverizers and air separators; conveying machinery made in Ohio; boilers from Waterous Manufacturing Company, Brandtford, Ont.; a cross compound reciprocating Corliss engine; air compressor plant, and 500 K. W. electric generator. All machinery will be driven by individual motors. Fire brick furnished by Evens & Howard, St. Louis, Mo.

CEMENT DEALERS DISCOVER BIG SAVING IN RATES.

Cement dealers of Illinois have, by experiments during the past few months, found a way to make big savings over the rail rates by using the neglected waterways of the state. The experiments are a result of the recent rulings of the Interstate Commerce Commission and the State railroad and warehouse commission which make it impossible for the railroads to so cut rates again as to put canal boats out of business.

Illinois is particularly fortunate in having more than 1,000 miles of navigable waterways within its boundaries. The state is, in fact, almost an island with the Mississippi on its western border, the Ohio on the southern, the Wabash and Lake Michigan on the East and the two canals (Hennepin and Illinois & Michigan) cutting across from Chicago to Rock Island.

Traffic experts for the Illinois & Michigan commission at Lockport have just issued a rate chart showing the comparisons between the cost of shipping commodities, that ordinarily go in bulk, by rail and by barge. Cement is one of these.

Basing their statements on the experiments made during the fall months the commissioners say that modern shallow draft barges with internal combustion engines and loading machinery can make the long hauls at a cost to those who charter them of about 2 mills per ton mile. A barge could make the circuit of the state, from Terre Haute, Ind., down the Wabash, around the Southern end of Illinois to Grafton, up the Illinois river and through the I. & M. Canal into Chicago at an expense per ton to the shipper of $1.90.

La Salle is one of the big shipping points for cement. Experiments made there this summer show that the little 175 ton canal barges can be operated profitably by the manufacturers over the 96 miles of canal to Chicago at the 2 mill rate. In other words it costs 18 cents to send a ton of cement to Chicago and unload it from the barge into the lake front warehouse. The railroads charge 90 cents for handling the same ton, in carload lots.

By rail it costs $1.56 to ship a ton of cement from Chicago to Rock Island, a distance of 185 miles. A fleet of barges can make the trip over the two canals and deliver the cement on the waterfront for 37 cents a ton.

"This 2 mills per mile rate will be even less," said Supt. McDonald of the I. & M. canal, "after the legislature grants the $1,000,000 we ask for improvements. It is planned to use this money in enlarging the locks until they will permit the passage of a boat of four times the present tonnage. It costs a mere trifle more to operate a boat of that size than it does to handle a small one."

Rates on cement by rail and water between Chicago and a few points on Illinois waterways. Rate per ton:

Town.	Rail Rate.	Barge Rate.
Utica	$0.70	$0.18
La Salle	.90	.19
Peoria	1.20	.33
Grafton	1.40	.71
Alton	1.40	.75
E. St Louis	1.40	.80
Cairo	1.60	1.18
Burlington	1.56	.53
Quincy	1.40	.68
Paducah, Ky.	1.60	1.27

REDUCING CONVEYOR BELT COSTS.

In a belt conveying system, the largest single item of expense is the belt and large users of this machinery devote considerable study to this part of the equipment. The original cost of the belt constitutes from one-third to one-half the cost of the entire conveyor, increasing with the length of the conveyor. Belt renewals are also the largest item of up-keep, this cost varying according to so many conditions that no general rule can be laid down. There are however, certain general principles covering machinery of this type and proper observance of these principles may greatly reduce the cost of operation. In analyzing the causes of belt wear, we will consider first the wear caused by the material carried and second external causes. The material produces wear by (a) slipping on the belt due to its inertia at the loading chute, (b) slipping back on the incline of the conveyor, and (c) by rearranging its position on the belt between the loading and discharge points.

The first can only be overcome by delivering material to the belt at the belt speed. The chute should be inclined in the direction of the conveyor's travel so that the material may receive a certain impetus before it strikes the belt. A curved lip is sometimes advocated at the bottom of the chute but this arrangement is usually impractical and does not greatly reduce slippage. A more effective arrangement used under certain circumstances is to use a "V" shaped lip for the chute or a perforated plate which allows the fine material to drop onto the belt first, and then the larger lumps fall onto the fine material.

The second cause may be entirely overcome. On a properly designed conveyor, there should be no slippage whatever on the incline. For most materials the maximum inclination should be about 20 degrees, although this is sometimes exceeded under certain conditions. In all cases, it should be at least ten degrees less than the angle of repose of the material on the belt. Lumpy material has a tendency to roll back on the belt, unless intermixed with fines, and also an intermittent flow allows more slippage. All these conditions should be taken into account before determining the operating angle.

Rearrangement of the load is greatest in a deeply troughed belt and is reduced to a minimum on a flat belt. The present tendency is accordingly to use a very shallow trough. Twenty degrees is usually standard at the present time, whereas from 30 to 45 was common several years ago. The change has been made without perceptibly reducing the capacity, but with a great saving in belt wear. It is often well, however, to use deeply troughed carriers beneath the chute, one located about three inches behind the point of loading and two others closely spaced beneath the skirt boards.

The proper alignment of the carriers is also important in order that the belt may run perfectly true. This may be done by leaving one side of the carriers partially tightened. Then by running the conveyor empty, any tendency of the belt to run to either side may be corrected by tapping the carriers either forward or back. By going over them in this way, several times, the belt may be adjusted to run centrally and the carriers should then be tightened. A violation of this principle allows the belt to run against the guide idlers, and the sides of the chutes, thus rapidly wearing the edges of the belt.

Another point to be considered is the action of the weather. The sun's rays are as detrimental to rubber belts as to rubber tires, while rain, snow, and ice, are all injurious. Water may get between the

plies and rot the fabric, or may freeze and force the plies apart. In some cases, where no covering is provided, the belts are taken from the conveyor during the winter, but the best results may be secured by providing a permanent housing.

A steady feed is important, especially for an inclined conveyor, and it is good economy to provide an automatic feeder with all installations. Another very important consideration is the type of carrier used. The carrier must be constructed so that the pulleys will revolve freely in all weather, so as not to offer more resistance to the belt than is absolutely necessary. A ball-bearing carrier has practically no wearing effect upon the belt and it usually pays to use such a carrier even at an increased cost. The strength of the carrier should also be taken into consideration as a broken pulley can sometimes greatly injure or even ruin a belt.

By a careful observance of these principles, good service can always be secured from high grade belts.

REPORT OF THE COMITTEE ON REINFORCED CONCRETE.*

By Professor F. Schule, Chairman, Zurich.

The importance of careful investigation of the behavior of reinforced concrete structures under different conditions and loading is universally recognized and it is gratifying to note the records of recent tests conducted in the United States and Europe. These include reports of such work in Germany by Professor Kirch, of Vienna; in the United States by Prof. A. N. Talbot, Urbana, Ill.; in Great Britain, by Mr. Edward O. Sachs, F. R. S., London; in Denmark, by Prof. E. Suenson, Copenhagen, and in Switzerland, by the writer, Professor Schule.

Such investigations will only acquire their full value when the results obtained have been tabulated, as has already been done in the case of the flextion tests applied to beams. Numerous experiments have led to analogous results and thus form a basis for specifications on reinforced concrete. In beams subjected to bending strength up to the point of rupture the normal case is that in which the rupture is caused by the yield point of the steel being exceeded.

The abnormal cases, which it is most important to observe, are those in which the beam, subjected to compression, has been crushed before the yield point of the reinforcing steel under tension has been attained. or those in which the rupture has been brought about by shearing under the influence of such strains. Among the valuable information which might be afforded in the abnormal cases is the percentage of steel with which rupture commences in consequence of the crushing of the cement in the compression area; and in addition, in the case of beams ruptured by shearing, a statement of the maximum shearing strain of the concrete without reference to the steel, with the percentage of steel used, that is whether of straight or bent bars or stirrups at the ends of the beams.

For the case of simplicity the strain and percentage content should be referred to the useful section of the concrete in beams of rectangular section or in the webs of beams of T-section. Such values, being independent of the dimensions of the beams, would possess the great advantage of enabling the engineer to form a reliable judgment before proceeding to make exhaustive calculations. They would enable him to ascertain whether any important differences are inherent in the quality of the concrete or steel obtained from different countries. In the case of columns the experiments on the action of centric loads have been carried pretty far, but not sufficient progress appears to have been made with those dealing with the effect of eccentric loads, to enable one to propose, at present, that the chief results obtained should be tabulated.

The members of the committee have been requested to send in reports for each country, first, on the methods of testing the materials of which reinforced concrete is formed, and of the extent to which this means of control is exercised; second, on the progress made in the experimental examination of finished structures and to mention any necessary amplification of the examination of structural parts chiefly with the object of establishing more firmly the basis for determining the permissible strains, and of ascertaining the influence of age on reinforced concrete, so as to identify the circumstances which are adverse to the perfect preservation of the steel and the concrete.

Of particular interest is the study of the properties of reinforced concrete under the influence of external forces; among these are its physical properties under the influence of temperature, contraction in air, expansion under water and the influence of such external agencies as fresh water, sea water, steam, smoke, sulphurous acid, ammonia, oils, tar and electric currents. Investigations along these lines have made considerable progress mainly through the carrying out of the extensive experimental program laid down by the German reinforced concrete committee with the support of the State and of the large German associations.

Checking the Materials.

The checking of the materials used in reinforced concrete comprises a testing of the individual materials that make up the finished structure. The methods of testing steel and cement have been largely standardized, but it is to be noted in the case of cement that the accelerated tests for constancy of volume and particularly the test by boiling at 100 deg. are of great importance where the concrete is intended for structural work which will be exposed to dry air and protected from rain.

The importance of adequate tests for sand and gravel used in the manufacture of concrete is recognized and it is recommended that such tests should include the following characteristics: Origin and petrographical character, specific gravity, classification by screening through sheet metal screens with round perforations, volume of interstitial spaces in the dry state. The common distinction between sand and gravel, or stone chippings, should also be more closely defined by fixing 5 or 8 mm. as the diameter of the perforation in the delimiting screen.

The only interest attaching to the testing of the combined materials is in the determination of the crushing strength of the concrete; and even the recently proposed experiments with reinforced check beams serve no other purpose than to induce phenomena of rupture through the crushing of the concrete in the compression area that will check the crushing strength of the concrete by an indirect test. Test specimens for such purposes should be standardized as far as it is possible as it is felt that the influence of the air and the prevailing temperature can be more effectually determined on test pieces whose dimensions correspond to the thickness of the material in the structure; thus small cubes would be suitable for checking thin roof work, while larger masses should be used for thicker construction. It is noted that the chief test for concrete is, in some measure, a determination of the density. The specific gravity of the filling

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*Abstract of paper presented at the Sixth Congress, International Association for Testing Materials.

material, in general, varies but slightly from 2.55 to 2.70, while that of good quality Portland cement ranges from 3.10 to 3.15. Specimens to be used in a determination of the density should weigh at least 1 to 2 kg. and be detached from the structure. All factors which impair the tensile strength of the concrete except the quality of the cement also lower its density. Among these are unsuitable ratio of sand to gravel, insufficient proportion of cement and defective ramming. Thus, these checks will advantageously supplement the particulars furnished by the testing of special test pieces for the strength of the material.

Checking the materials separately and in combination forms an important factor for the safety of the structure, though the differences in the test pieces used seem to complicate the matter and hinder elucidation. It is exceedingly important that checks should be applied and as regularly as possible. Further experience will thus show which are the safest and most practical methods to adopt.

It is strongly recommended that a uniform method of notation be adopted for all countries. Such a notation will greatly facilitate the preparing of various reports and experimental data relating to reinforced concrete by avoiding any confusion of symbols. The committee has submitted such a notation, subject to slight modification for use in English-speaking countries.

LOUISIANA GRAVEL COMPANY.

The Louisiana Sand, Gravel & Construction Company, West Monroe, La., advises us that they do not operate any crushers at their plant as the gravel is of the correct size, all passing an 1½-inch perforation. They are mining sand and gravel with a Marion Model No. 60 steam shovel, manufactured by the Marion Steam Shovel Company, Marion, Ohio, which they own, as well as standard gauge locomotives and four miles of standard gauge, 60 feet track. The Marion steam shovel, they declare, is giving splendid results.

The American Cement Tile Manufacturing Company, of Pittsburgh, Pa., has received a contract from the Isthmian Canal Commission for roofing the new Balboa shop buildings with "Bonanza" reinforced cement tile. There are 16 buildings, requiring about 650,000 square feet of tile. The company will establish a plant for making the tile on the Isthmus.

Mr. A. C. Chenoweth, proprietor of the Chenoweth concrete pile patents, of Brooklyn, N. Y., has concluded a contract for the manufacture of piles of this type at Hannibal, Mo., for use on the Chicago, Burlington & Quincy Railroad, the Northern Pacific Railway and the Great Northern Railway.

AERIAL WIRE ROPE TRAMWAY.

The Winchester Granite Brick Co., Winchester, Ky., has just completed another new aerial tramway for the handling of sand, which will bring their capacity up to twelve cars a day. The new tramway was furnished by the Broderick & Bascomb Co., St. Louis, Mo. The Winchester Granite Brick Co. reports that they have about all the business they can take care of. Speaking of general conditions, they say: "Old Kentucky looks very fair. Abundant crops, at high prices, ought to send things along at a good giat from this time on. Farmers are building tobacco warehouses and silos right along."

BIG CEMENT PLANT NEARLY FINISHED.

Work on the plant of the Olympic Portland Cement Company at Bellingham, Wash., is progressing rapidly, considerable trouble is being experienced in getting shipment of material from the East. Five of the huge storage silos at the plant are now complete. These have a capacity of 10,000 barrels each and are used to store the finished product of the plant. Five more of the huge silos are now being erected. It is estimated that the 50,000 barrel oil tank being erected will be completed within the next six weeks.

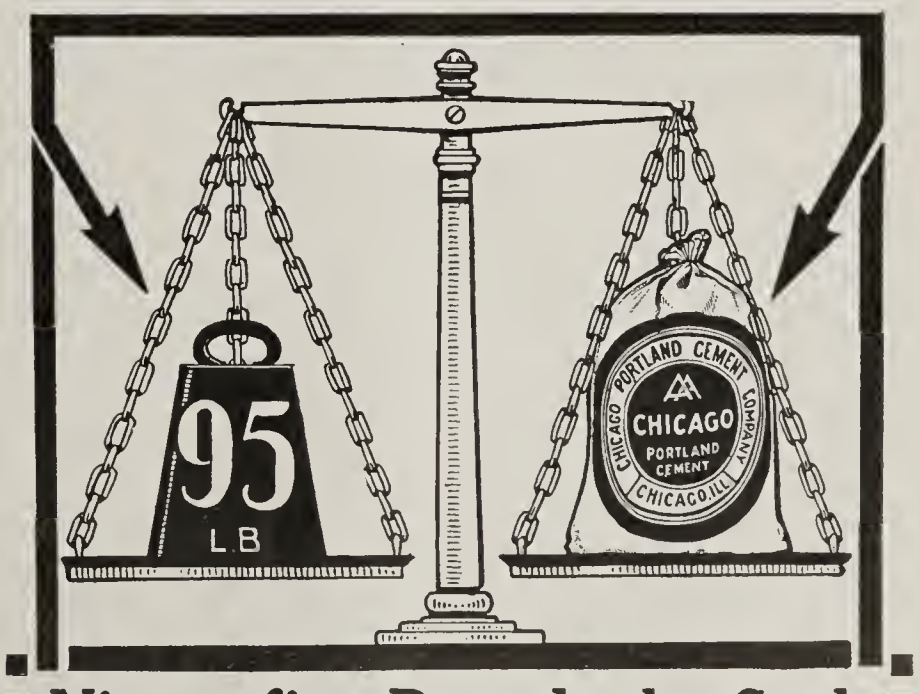
Although it was planned to have the plant ready for operation by January 1, those in charge state that the numerous delays have made this impossible. The failure of structural steel to arrive in time has somewhat delayed other work, it is declared.

The placing of corrugated steel on the framework of the buildings is now under way. The sheeting on the clay storage warehouse is also being set in place at the present time. The erecting of elevators and conveyors has not yet been commenced. This work will require only a short time, it is stated, after the structural steel is in plaec.

The Security Cement & Lime Company, whose main offices were in Baltimore, Md., have moved their headquarters and executive offices to Hagerstown, Md.

The entire executive departments, including sales and purchasing, will be located in Hagerstown so that closer co-operation may be had between the Portland cement plant at Security, Md., two miles from Hagerstown, and with the Berkeley lime plant, at Berkeley, W. Va., which is 16 miles from the executive offices.

A Baltimore district office will be maintained in the Equitable building, though all communications should be sent direct to the new executive offices.



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J. U. C. McDANIEL, Sales Manager

Among The Cement Mills

NEW CHOCTAW PLANT.

It is expected that in another month or so the plant of the Choctaw Portland Cement Company in Hartshorne, Oklahoma, will be in operation. The capacity is to be 1,400 barrels a day. The company is capitalized at $1,200,000. C. B. Blake, Oklahoma City, is president. The plant equipment is described in the Manufacturers' Record as follows: The office building is 28x28 feet, of concrete construction, two stories high, and the machine shop is 100x40 feet, of fireproof concrete and steel construction. The coal mills is 117x34 feet, and is equipped with three 30-inch Griffin mills, driven by a 100-horse-power motor. Modern equipment has been installed in the rock-crushing plant, the rock passing from the bins under the screen into tramway cars, which are operated by a continuous cable along a tipple 400 feet long to the raw grinding building. The company's rock-loading tracks have a capacity for 50 cars. The material after passing through the driers will be emptied in sheet steel and concrete tanks, from which it will pass into two 7x9 ball mills, and from these into an 8x26 tube mill, one of the largest in operation. The dry kilns are 8 feet in diameter and 110 feet long, the waste heat being utilized by passing it over vertical-tube boilers. The steam from these boilers is passed through turbines developing electricity to operate the entire plant. From the storage bin the clinker passes into a finishing mill, where it is ground by five 40-inch giant Griffin mills and carried by a conveyor to the blockhouse, which will be of concrete and stone construction, 140x75 feet. Sacking will be done by automatic sacking machinery. The company's deposits to be developed stand as a bare ledge 200 feet high and 2½ miles in length, the shale lying immediately under the rock.

RESIGNED.

Howard H. Leh, has resigned his position in the chemical department of the Cowell Portland Cement Company, Cowell, Cal., to accept a position as chief chemist with the Old Mission Portland Cement Company, who are building a 4,000 barrel daily capacity plant at San Juan Bautista, Cal.

CEMENT PLANT BANKRUPT.

A receiver was appointed for the Altoona Portland Cement Company of Altoona, Kas., January 13th by Judge John C. Pollock in the federal court, Kansas City, Kans. T. A. Parker, president of the company, admitted the corporation was insolvent. Four of the creditors of the company appeared through their attorney, Samuel Maher, and asked for the appointment of the receiver. They represented debts of the company amounting to $3,000.

The petition in bankruptcy was filed at Fort Scott yesterday morning. In the afternoon the president of the company, the attorney for the creditors, C. W. Lyon, a former superintendent of the plant and the prospective receiver; H. M. Beardsley, the prospective attorney for the prospective receiver; a representative of a surety company to write the prospective bond for the prospective receiver, and W. S. Willets, one of the creditors, appeared before Judge Pollock. The petition was read, the prospective receiver appointed, the prospective attorney received his commission, the surety man wrote the bond, and the Altonna Portland Cement Company was in the hands of a receiver, to be guided by the federal court.

The company is capitalized at $800,000 and, according to Judge Pollock, has debts amounting to between ¼ million dollars and $300,000. The plant has been closed since July. The persons in court refused to give a reason for the receivership other than the low price of cement. Two other Kansas cement plants have gone into the hands of receivers in the last two months and cement men look for others to follow. The reason given in both cases was the scarcity of gas, which forced the companies to replace the gas boilers with coal burners at a cost of approximately $40,000 Both the other plants were capitalized at a million dollars each.

The petitioners in the case were A. H. Lamp of Davenport, Ia.; W. S. Willetts of Altoona, A. C. Baker of Cresco, Ia., and W. A. Rogers of this city.

OUTLOOK GOOD FOR CEMENT BUSINESS.

F. T. Brown, traffic manager of the Inland Portland Cement Company, Spokane, Wash., returned today from a month's trip in the east. He conferred with the head offices of the Lehigh Portland Cement Company in Chicago and later visited several of that company's mills in the Indiana district.

Mr. Brown says that the exceedingly moderate weather in the east and middle west up to the first of January made the cement business particularly good and that construction was carried on almost without interruption up to the first of the year. The outlook for a big increase in business after the weather opens up in the spring is particularly good and in fact has not been exceeded in years.

The conditions in the middle west for increased business within a few months are similar to the conditions existing in the northwest, said Mr. Brown.

THE ALPHA PLANT.

The Mesta Machine Company, Pittsburg, Pa., has received an order from the Alpha Portland Cement Company, Easton, Pa., for three gas engines, having cylinders, 28-inch diameter by 36-inch stroke, to operate at a speed of 150 R. P. M. each arranged to drive direct connected a 600 K. W., 60 cycle, 3 phase, 600 volt, alternating current Westinghouse generator. The engines will be located at Cementon, N. Y., near Catskill, and will operate in parallel with four producer gas engines now in service. Gas is generated through superimposed pressure type producers using Bituminous coal as fuel.

EXTENSIVE IMPROVEMENTS.

The Ashland Fire Brick Company, Ashland, Ky., whose clay deposits are located in Carter county, Kentucky, and are considered to be the finest in the world, are completing improvements providing for the most progressive methods in the United States of handling their raw material. Their fine clay will be subjected to a process still further increasing its refractory and abrasive qualities. And an improved grinding system will more than ever render their fire brick "fine ground and close grained."

Cost and service considered superintendents of Portland cement plants find from experience that Ashland fire brick for lining rotary kilns is the best. Because they give longer service in the kiln than any others, as the coating which is formed by the material which passes through the kilns adheres well to the brick.

Among The Cement Mills

A. ST. J. NEWBERRY PASSES AWAY.

Mr. Arthur St. John Newberry, president and treasurer of the Sandusky Portland Cement Company, died at his home in Cleveland, Ohio, Nov. 30, 1912, after an illness of but four days. Pneumonia was his ailment.

Mr. Newberry was born in Cleveland, the second son of Dr. John S. Newberry, professor of geology at Columbia University of New York and State Geologist of Ohio and a scientist of world-wide reputation, who died in 1892. Mr. Newberry was 58 years of age at the time of his death. He graduated from Harvard University in 1876, studied law in the office of Judge Ranney in Cleveland and practiced law for some years. He was active in the organization of a number of important enterprises including the Sandusky Portland Cement Co. and the Bucyrus Co., now in South Milwaukee, Wis. He founded the Sandusky Portland Cement Co. in 1892 and was president of the company continuously since that time until his death.

He was also a member of the board of directors of the Cement Products Exhibition Co.

ASSOCIATION OFFICERS ELECTED.

At the annual meeting of the Association of American Portland Cement Manufacturers, held in New York, December 11 and 12, Mr. John C. Lober was elected president to succeed Mr. Edward M. Hagar. The full list of officers elected is as follows:

President—John B. Lober (Pres. Vulcanite Portland Cement Co.), Philadelphia.

Vice-President—Robert S. Sinclair (Vice-Pres. Alsen's American), New York.

Treasurer—W. H. Harding (Pres. Whitehall), Philadelphia.

Executive Committee—A. H. Craney, Jr. (Union Sand), St. Louis; T. Henry Dumary (Helderberg), Albany, N. Y.; Edward M. Hagar (Universal), Chicago; Richard Hardy (Dixie), Chattanooga, Tenn.; R. W. Kelley (Virginia), New York; R. W. Lesley (American), Philadelphia; D. McCool (Newaygo), Grand Rapids, Mich.; W. S. Mallory (Edison), Stewartville, N. J.; John A. Miller (Dexter), Nazareth, Pa.; John R. Morron (Atlas), New York; L. T. Sunderland (Ash Grove), Kansas City, Mo.; Frank E. Tyler (Dewey), Kansas City, Mo.

NEW PORTLAND CEMENT PLANT FOR NEW ZEALAND.

The first meeting of the board of directors of the Dominion Portland Cement Company, Ltd., capital $1,250,000, was held on December 10, 1912, at the company's registered office, Wellington. Mr. S. J. Nathan, of Auckland, occupied the chair.

The minimum number of shares having been oversubscribed, the directors proceeded with the allotment. Four additional directors were appointed—Messrs. Thomas Buxton, M. P. (Temuka). Robert McNab (Palmerston North), Vernon Reed, M. P. (Bay of Islands), and George Winstone, merchant (Auckland). Mr. Ernest Hunt, of Wellington, was appointed secretary, and Mr. W. J. Wilson, of Warkworth, Auckland, late works manager of Wilson's Portland Cement Company, has been appointed manager.

Mr. Vernon Reed, on his appointment as chairman of directors, congratulated the company upon its having received the minimum application for shares within three weeks of the issuing of the prospectus. This was most satisfactory, in view of the present position of the money market and the very keen opposition that the company had received from rival cement companies.

The company proposes to operate on cement rock deposits, of which there are sufficient to last for centuries, in Whangarei harbor. It is intended to at once put in hand the erection of plant, with a view to commencing operations within the next eighteen months. The works will be double the size of any existing cement works in the Dominion.

Whangarei possesses a well-sheltered deep-water harbor. The works will be situated on the railway line about five miles from the township of Whangarei, within easy reach of coal supplies. The starting of this new industry will mean the employment of a large number of men and the distribution of many thousands of pounds in wages yearly. It is proposed to utilize hydro-electric power, supplied by the Whangarei borough from the Wairus Falls, situated some fourteen miles from the cement plant.

Edwards & Lazell, chemical and efficiency engineers, 426-429 Railway Exchange Building, Portland, Oregon, have been successful in obtaining the testing of all the cement to be used in the construction of the improved waterway between Lakes Union and Washington, near Seattle. This work will involve the sampling and testing of about 200,000 barrels of cement under the government specifications as outlined in Bulletin No. 33 of the Bureau of Standards.

To carry out this work they have installed a full laboratory equipment at the plant of the Superior Portland Cement Company, at Concrete, Washington. The work will receive the careful supervision of both of these gentlemen.

O. B. Monahan, of Allentown, Pa., resigned as general superintendent of the Lehigh Portland Cement Company, in order to engage in business for himself as an expert in drilling and blasting. This venture of Mr. Monahan is very unique and is aimed to fill a long-felt want in the development of efficiency among handlers of high explosives. He is recognized as a man of great knowledge and experience, having made extensive studies in explosives in the United States and Mexico. He has spent fourteen years compiling data with the one idea in view of reducing to a minimum the hazards connected with the handling of explosives in the cement and stone industries.

G. P. Grimsley, Ph. D., mining and consulting geologist, has recently opened an office at Room 1105, Wyandotte building, Columbus, Ohio, and is in position to make examinations and prepare reports of coal properties, oil and gas, iron ores, Portland cement locations, lime and limestone, clays and building stone, gypsum and plaster deposits, etc.

Mr. Grimsley has had long experience in the above mentioned mineral lines and is thoroughly qualified to determine the true status of properties. His services have been sought by many of the leading concerns, railroads, state geological surveys, boards of agriculture, etc., and in every instance his splendid work is attested to by those whom he served.

Among The Cement Mills

PORTLAND CEMENT IN 1912.

According to returns received by the United States Geological Survey up to January 15, 1913, it is estimated by Ernest F. Burchard, of the Survey, that the total quantity of Portland cement manufactured in the United States in 1912 was approximately 81,941,998 barrels. It is believed that this estimate is within 1.5 per cent of the exact figure. This quantity represents an increase of 3,413,361 barrels over the 78,528,637 barrels manufactured in 1911, or 4.3 per cent. The shipments of Portland cement during 1912 are estimated at 84,750,291 barrels, compared with 75,547,829 barrels in 1911, an increase of 9,202,462 barrels, or 12.2 per cent. The production in 1912 was thus held in check sufficiently to permit a material reduction in the stocks of cement at the mills at the close of 1911, which amounted to nearly 12,000,000 barrels.

The continued increase in the production of Portland cement is significant in view of the fluctuations in the output of other leading mineral products, such as coal, iron, and copper. The curve of production of Portland cement, although not rising at so rapid a rate as during 1909 and 1910, is still pointing upward and has yet to take its first downward drop.

Business Conditions and Prices.

Practically all mills report having to contend with adverse business conditions during the first six months of the year. Prices were lower than the average for 1911 during this period, and some plants reported the lowest prices for which they had ever sold cement. After the middle of the year conditions improved materially and generally during the last four months of 1912 the demand for Portland cement was sufficient to keep most mills running at full capacity. In the Lehigh district production was curtailed slightly in order to diminish accumulated stocks. Production and shipments in New York show the greatest proportionate increase of all districts. In the Southeastern States the increase in production and shipments was gratifyingly large, as it was also in the vicinity of Chicago, Ill., and in Iowa and Missouri. Certain plants in Kansas were much hampered by the failure of the supply of natural gas, and were obliged to shut down temporarily while installing coal-burning devices. This feature contributed to the decrease in production in the Great Plain States. In the Pacific Coast States and in certain of the Rocky Mountain States production did not keep pace with that of 1911, owing to the lack of demand for cement for large public works.

The average price for the whole country of Portland cement per barrel in bulk at the mills will probably show a slight decrease when the complete returns are received, although at the close of the year prices were much better than they had been during the last two years.

Production by Districts.

In addition to estimating the total production and shipments of Portland cement during 1912 it is possible to present fairly complete statistics of production and shipments by districts.

Lehigh district.—Eastern Pennsylvania and New Jersey, which together form the leading Portland cement manufacturing district of the United States, produced approximately 24,449,523 barrels of Portland cement in 1912, compared with 25,972,108 barrels in 1911. This represents a decrease of 1,522,585 barrels, or 5.9 per cent. The shipments of Portland cement in 1912 approximated 25,905,257 barrels, compared with 25,192,464 barrels shipped in 1911, an increase of 712,793 barrels, or 2.8 per cent. There were 20 mills reported as active in 1912, against 24 in 1911.

New York.—Mills in the State of New York produced approximately 4,490,180 barrels of Portland cement in 1912, compared with 3,314,217 barrels in 1911. This represents an increase of 1,175,963 barrels, or 35.5 per cent. The shipments of Portland cement in 1912 approximated 4,547,195 barrels, compared with 3,058,463 barrels shipped in 1911, an increase of 1,488,732 barrels, or 48.7 per cent. There were 7 mills reported as active in 1912, the same number as in 1911.

Ohio and western Pennsylvania.—In Ohio and western Pennsylvania there were produced approximately 7,239,775 barrels of Portland cement in 1912, compared with 6,756,313 barrels in 1911. This represents an increase of 483,462 barrels, or 7.2 per cent. The shipments of Portland cement in 1912 approximated 7,400,885 barrels, compared with 6,654,269 barrels shipped in 1911, an increase of 746,616 barrels, or 11.2 per cent. There were 9 mills reported as active in 1912, the same number as in 1911.

Michigan and northeastern Indiana.—This district produced approximately 4,449,274 barrels of Portland cement in 1912, compared with 4,519,726 barrels in 1911. This represents a decrease of 70,452 barrels, or 1.6 per cent. The shipments of Portland cement in 1912 approximated 4,451,838 barrels, compared with 4,550,896 barrels shipped in 1911, a decrease of 99,058 barrels, or 2.2 per cent. There were 12 mills reported as active in 1912, the same number as in 1911.

Kentucky and southeastern Indiana.—Mills near Ohio River in Kentucky and Indiana produced approximately 3,071,467 barrels of Portland cement in 1912, compared with 2,818,820 barrels in 1911. This represents an increase of 252,647 barrels, or 9 per cent. The shipments of Portland cement in 1912 approximated 3,134,874 barrels, compared with 2,800,526 barrels shipped in 1911, an increase of 334,348 barrels, or 11.9 per cent. Three mills were reported as active in 1912, the same number as in 1911.

Southeastern States.—Mills in the state of Maryland, Virginia, West Virginia, Tennessee, Georgia and Alabama produced approximately 4,664,454 barrels of Portland cement in 1912, compared with 4,049,063 barrels in 1911. This represents an increase of 615,391 barrels or 15.2 per cent. The shipments of Portland cement in 1912 approximated 4,961,662 barrels, compared with 3,723,183 barrels shipped in 1911, an increase of 1,238,479 barrels, or 33.3 per cent. There were 9 mills reported as active in 1912, against 11 in 1911.

Iowa and Missouri.—The output of Portland cement in Iowa and Missouri amounted to approximately 7,557,090 barrels in 1912, compared with 6,067,449 barrels in 1911. This represents an increase of 1,489,641 barrels, or 24.6 per cent. The shipments of Portland cement in 1912 approximated 7,792,163 barrels, compared with 5,932,856 barrels shipped in 1911, an increase of 1,859,307 barrels, or 31.3 per cent. There were 8 mills reported as active in 1912, against 7 mills active in 1911.

Great Plains States.—In Kansas, Oklahoma and central Texas approximately 5,760,938 barrels of Portland cement were produced in 1912, compared with 7,010,396 barrels in 1911. This represents a decrease of 1,249,458 barrels, or 17.8 per cent. The shipments of Portland cement in 1912 approximated 6,152,378 barrels, compared with 6,332,698 barrels shipped in 1911, a decrease of 180,320 barrels, or 2.8 per cent. There

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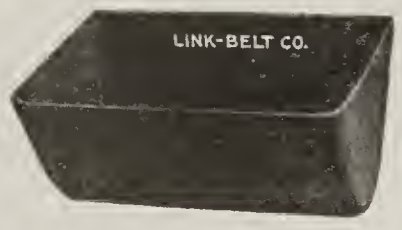

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were 15 mills reported as active in 1912, against 17 mills active in 1911.

Rocky Mountain States.—Colorado, Utah, Montana and western Texas together produced approximately 2,298,649 barrels of Portland cement in 1912, compared with 2,124,930 barrels in 1911. This represents an increase of 173,719 barrels, or 8.2 per cent. The shipments of Portland cement in 1912 approximated 2,234,766 barrels, compared with 1,994,790 barrels shipped in 1911, an increase of 239,976 barrels, or 12 per cent. Seven mills were reported as active in 1912, and the same number in 1911.

Pacific coast.—The states of California and Washington produced approximately 7,258,542 barrels of Portland cement in 1912, compared with 7,278,274 barrels in 1911. This represents a decrease of 19,732 barrels, or 0.3 per cent. The shipments of Portland cement in 1912 approximated 7,483,852 barrels, compared with 6,770,242 barrels shipped in 1911, an increase of 713,610 barrels, or 10.5 per cent. There were 11 mills reported as active in 1912, the same number as in 1911.

in the raw end and the other for handling the clinker. For shipment by rail, the company has both Grand Trunk and Canadian Pacific Railway connections.

The president of the St. Mary's Portland Cement Company, Limited, is Mr. Geo. H. Gooderham, and the secretary-treasurer is Mr. Mark H. Irish, both of Toronto. Mr. John G. Lind, the manager of the plant, is located at St. Mary's.

IMPORTANCE OF CANADA'S CEMENT INDUSTRY.

The production of cement in Canada during the past few years though all classed as Portland, has included an output of Puzzolan cement, made from blast furnace slag at Sydney, N. S., and a small production of "natural Portland" made at Babcock, Manitoba, 75 miles southwest of Winnipeg on the Canadian Northern Railway. The total quantity of cement made in Canada during 1911, as per reports received from the manufacturers, was 5,677,539 barrels of 350 pounds net each, or 993,569 tons, as compared with 4,396,282 barrels, or 769,349 tons, made in 1910—an increase of 1,281,257 barrels, or over 29 per cent, states the report of Mr. J. McLeish, B. A., chief of the division of mineral resources and statistics.

The total quantity of Canadian Portland cement sold in 1911 was 5,692,915 barrels, or 996,260 tons, as compared with 4,753,975 barrels, or 831,946 tons, in 1910, an increase of 938,940 barrels, or nearly 20 per cent.

The total production of Portland cement in 1911, including Canadian and imported cement, was 6,354,831 barrels of 350 pounds net, or 1,112,095 tons, as compared with 5,103,285 barrels, or 893,075 tons, in 1910—or an increase of 1,251,546 barrels or nearly 25 per cent.

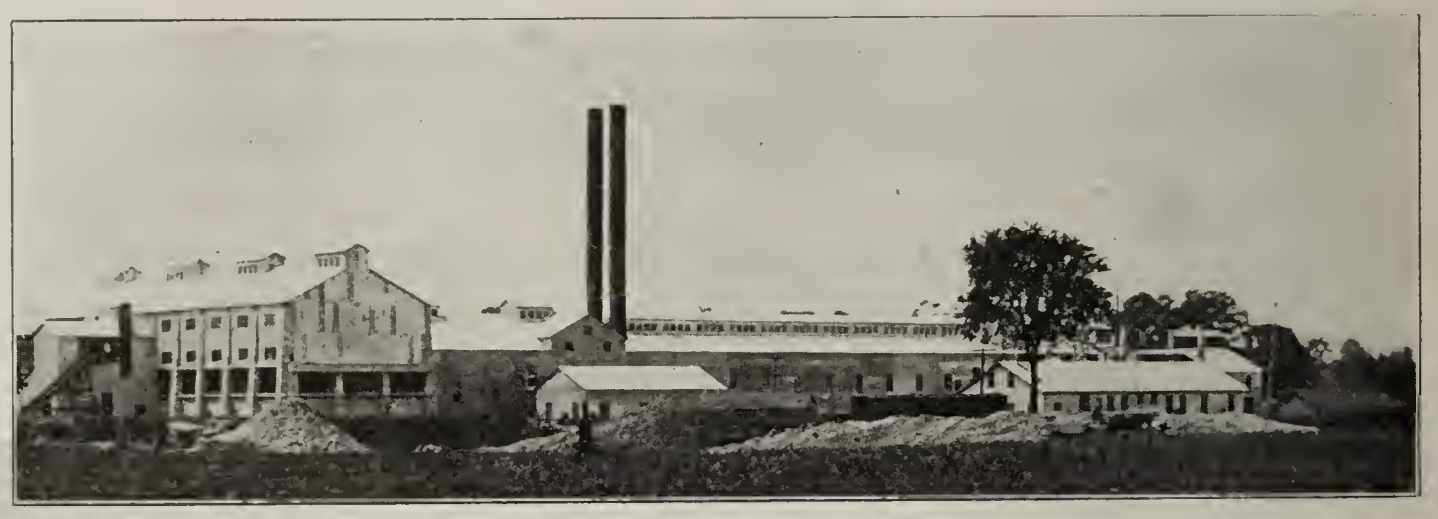
The cement industry has been rapidly growing in importance, and its output is now exceeded in value amongst non-metallic products by coal and clay products only.

An average of 3,010 men were employed in 1911, the total wages paid being reported as $2,103,838.

The increase in annual production since 1905 has been nearly four-fold. The production per capita in 1911 was about 278 pounds, as against only 79 pounds in 1905. The approximate consumption per capita has increased during the same period from 115 pounds to 310 pounds.

A similar rapid increase in both production and consumption has taken place in the United States, where the annual production now exceeds 75,000,000 barrels.

The production per capita in the United States was



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THE PLANT OF THE ST. MARY'S PORTLAND CEMENT COMPANY.

The plant of the St. Mary's Portland Cement Company is located at St. Mary's Ontario. Its daily capacity is 1,500 barrels, and storage capacity has been provided for 75,000 barrels.

The illustration shows all the buildings except the warehouse. The photograph was taken before they were completed.

The quarry for limestone and the clay beds are contiguous to the mills. The plant is operated by hydro-electric power, 550-volt, 25 cycle, three-phase current being used. The company have their own substation, and find the power very satisfactory.

At the raw end a No. 8 Kennedy crusher is set over a No. 5 Jumbo Williams mill. The limestone is crushed by this to 1½ inches down. The clay is washed as it goes to the mill. The machinery includes two large size kominuters with Trix separators; two large size Smidth tube mills, and five concrete tanks. The kilns are two in number, and are 8 ft. by 160 ft. The coal is brought in on elevated tracks, is dried in a Cummer dryer, and is ground in a 42-inch Fuller Lehigh mill. Two coolers, 6 ft. by 70 ft., are provided, with a fan attachment which is used for blowing the cold air in at the lower end and using the hot air from the upper end of the cooler both for the kilns and drying the coal.

In the finished product end, there are three Dreadnought Fuller Lehigh mills for finishing the cement.

The mill is provided with two electric cranes, one

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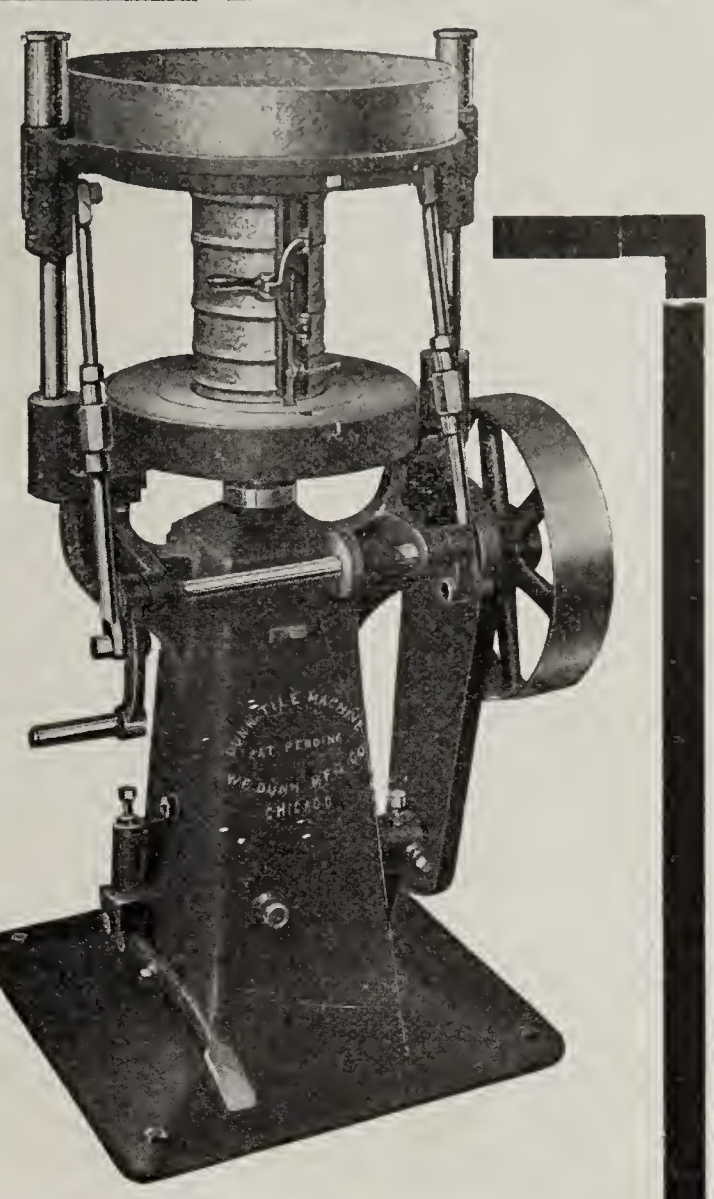
We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.



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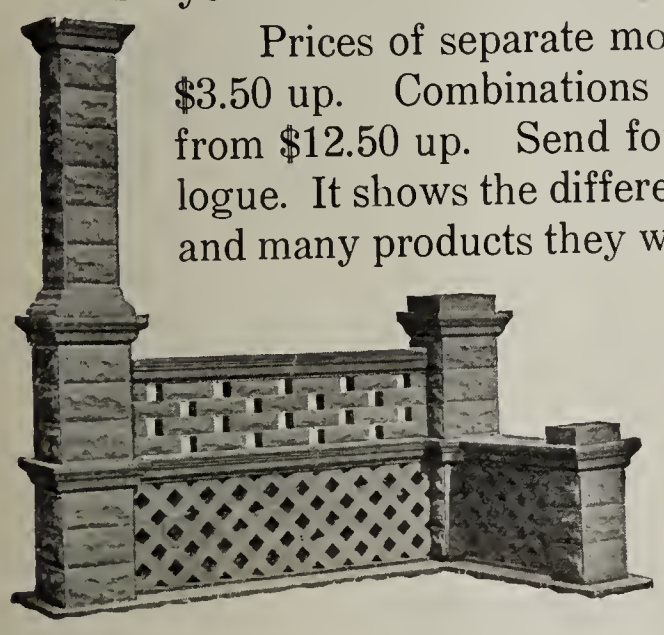
Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.



Prices of separate molds from $3.50 up. Combinations of molds from $12.50 up. Send for a catalogue. It shows the different molds and many products they will make.

Poured Sewer Pipe Molds

No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

W. E. DUNN MFG. CO.

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in 1910 about 332 pounds, as against 204 pounds in 1905.

The production of cement in 1911 was derived from 24 operating plants, having a total daily capacity of $28,281, the operating plants being distributed as follows: one in Nova Scotia, using blast furnace slag; one in Manitoba, making a natural Portland cement; one in British Columbia; three in Alberta; three in Quebec, using limestone and clay; and fifteen in Ontario, of which twelve use marl and three limestone.

Of the total quantity of cement made in 1911, 1,626,857 barrels were made from marl and 4,050,682 barrels from limestone and slag. In 1910, there were 1,214,479 barrels made from marl and 3,181,803 barrels from limestone and slag, and in 1909, 819,706 barrels were made from marl and 3,336,002 barrels from limestone and slag. Practically all of the newer plants erected during the past few years have been limestone plants. The proportion of cement made from marl in 1908 was about 45 per cent of the total output, as compared with about 28 per cent in 1911.

The consumption of cement is represented practically by the domestic production together with the imports, the exports being so comparatively small as to be negligible. The total consumption of Portland cement in Canada in 1911 was 6,354,831 barrels (1,112,095 tons), made up of 5,692,915 barrels (996,260 tons) of Canadian cement, and 661,916 barrels (115,835 tons) of imported cement; the Canadian cement representing 90 per cent and the imported cement 10 per cent of the total.

In 1910 the total consumption of cement was 5,103,285 barrels (893,075 tons), of which 93 per cent was of domestic production and 7 per cent imported. In 1901 the total consumption was 872,966 barrels (152,769 tons), of which only 36 per cent was made in Canada and 64 per cent imported.

The following is an estimate of the annual consumption of Portland cement in Canada during the past eleven years:—

Calendar Year.	Canadian		Imported.		Total
	Barrels	%	Barrels	%	Barrels
1901	317,066	36	555,900	64	872,966
1902	594,594	52	54 ,954	48	1,139,548
1903	627,741	45	773,678	55	1,401,419
1904	910,358	54	784,630	46	1,694,988
1905	1,346,548	59	918,701	41	2,265,249
1906	2,119,764	76	665,845	24	2,785,609
1907	2,436,093	78	672,630	22	3,108,723
1908	2,665,289	85	469,049	15	3,134,338
1909	4,067,709	97	142,194	3	4,209,903
1910	4,753,975	93	349,310	7	5,103,285
1911	5,692,915	90	661,916	10	6,354,831

The Arrowhead Portland Cement Co., San Bernardino, Cal., has filed articles of incorporation here with $750,000 capital stock. The incorporators are John Moran, William Stewart, Melville Sheldon, Robert A. Todd and John Castera, all of Los Angeles.

The Canadian Inspection and Testing Laboratories, Ltd., of Montreal, will locate a cement testing plant in the Lougheed Building, Calgary, Alberta.

OMEGA CEMENT PLANT.

The Omega Portland Cement Co., Jonesville, Mich., has shut down and is undergoing repairs which are expected to be finished March 1st. John S. Lewis, Jr., is superintendent. The plant has a daily capacity of 600 barrels. They have five 6x60 feet kilns. Wet process, using marl and clay; marl is handled by pneumatic pumps; raw mix ground in tube mills. Coal is ground in Raymond mills and clinker in Bonnot mills.

WILLIAM F. COWHAM.

William F. Cowham died January 13, at Jackson, Mich., after an illness of seven weeks. The news was a shock and a surprise to the citizens generally, for while his illness has been known there was little reason to apprehend a fatal termination. But as the events of the last few months are considered there is discovered evidence that he himself had premonitions that he must curtail the field of his activities, and indeed, made the first steps in that direction by withdrawing from the presidency of the Western States Cement Company, but this withdrawal did not affect his interest in the affairs of this or any of the other companies with which he was associated, and until the very last, even in the sick room, he was true to the practices of his entire life, and literally died with business cares ever in his mind, says the Jackson Herald.

To write his life would be to write the history of the reaper business in this state, and the development of the cement industry in the entire country, with diversions into high-bred horse raising and scientific farming.

He was born in Burlington, Wis., October 22, 1844, and came to Jackson in 1865 in the interests of the McCormick Reaper company. Before this he had demonstrated his natural ability as a salesman by selling Harper's school charts, and this experience was duplicated in the larger field offered by the implement business. His energy was unbounded, and his success was corresponding. Through his zeal he made his territory one of the very best paying agencies of the McCormick company, and in the year before he resigned to begin his later and successful efforts in the production of cement he made the record of selling the most machines in one year of any general agent, and with the least expense. His capacity was appreciated by the parent company, and he was pointed out as the model general agent of the company.

In 1898 Mr. Cowham acquired marl rights at Cement City, Mich., and in 1899 organized the Peninsular Portland Cement Company. It was another instance of his ability to look into the future, and converting his vision into a prosperous business reality. The National Portland Cement company and the International Portland Cement Company were organized in Canada, the Southern States Portland Cement Company at Rochmart, Ga., following these. Then came the Northwestern States at Mason City, Ia., and the Southwestern States Portland Cement Company at Eagle Ford Texas, near Dallas, these last with the Peninsular company, forming the Cowham system, which is to the cement industry what the Steinway is to the music world. Nothing better illustrated the sagacity of Mr. Cowham than in the location of these plants, where there exists both the material for the production of the highest grade cement, and also a country which is practically without lumber, and where the use of cement is certain to increase with the coming years.

He was president and general manager of the Kasigan Oil, Gas and Power company, a company which has made large developments in southern Kansas and Oklahoma oil and gas fields and is now operating on a large scale in that territory.

The Cowham Engineering company, the W. F. Cowham Engineering company and the Peninsular Engineering company were all under his direction. Besides these he was president of the Cutting Motor Car company of Jackson, Mich., and president and general manager of the southwestern branch of the Cuttling Motor Car company at Kansas City, and many other enterprises of less note have been created by his assistance.

Is it the first cost of Elevating Equipments that keeps you from installing them?

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have many advantages that greatly outweigh the first cost, which is the only cost.

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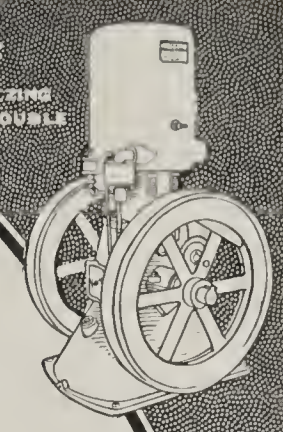

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Learn more about this Low Freezing Gelatin. Send for Circular No. 112.

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America's Pioneer Powder Makers
WILMINGTON, DEL.

All his life he had been an enthusiastic horseman, and in the years of his greatest efforts in the machine business he sought diversion from those cares by gratifying his admiration for a good horse. The Greenwood Stock farm was known as the home of a succession of standard sires, and Truro, A. V. Pantlind and Lee's Pilot were his contributions for the improvement of the thoroughbreds of Jackson county. He had 1,500 acres in Kansas at the time of his death on which there were fine horses, and in Michigan he owned several farms, upon which he used his good sense in matters agricultural.

Under the firm name of Cowham & Scofield for many years a profitable business was done in retailing buggies and agricultural implements, and as the Michigan Buggy company, in the '80s, a line of buggies was made for the trade.

To help others was one of the articles of his religion, and there are many now in business who got their start from the aid given them by Mr. Cowham. He had a talent for judging men, and was faithful to that belief even to a loss, and had the satisfaction of seeing his judgment confirmed by a later success.

He was a Mason, an Elk, a member of the Chamber of Commerce, a practicer of the widest but hidden charity, and was a participator in all public enterprises of the city.

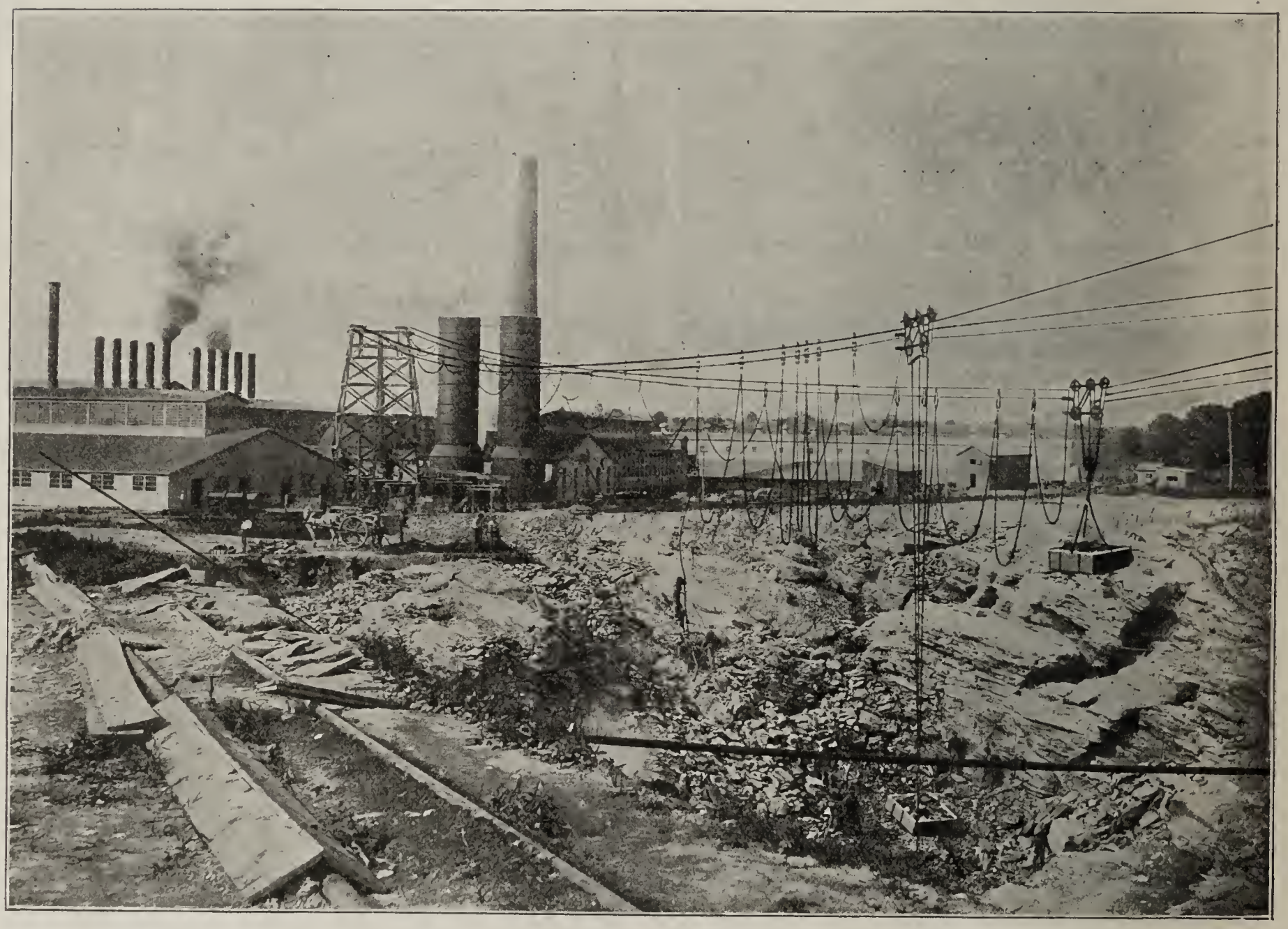
VIEW OF QUARRY AT VULCANITE CEMENT PLANT.

This illustration represents two cableways supported at each end by specially constructed towers, as shown by the engravings.

Each tower is 80 feet high and the cables have a clear span of over 900 feet. The main cables are 2¼ inches and the other wire ropes ¾ inch in diameter. Each cableway is operated with one 11x14 Double Cylinder, Double Friction Drum and Reversible Link Motion Engines. The carriage traveling on the cables is fitted with three sheaves, thereby distributing the weight of the load equally on the sheaves, running free and easy and reducing the wear to a minimum.

The maximum carrying load is 7 tons. The daily capacity is from 800 to 900 tons per 10 hours. The material is loaded into skips which are made of steel, and a special arrangement is provided at the head tower to discharge the contents into the cars to be delivered to the crusher.

The towers are made sufficiently wide to support two cableways. The anchorages consists of two logs which are placed in a ditch from 5 to 6 feet deep and filled up with concrete. In many places the logs are weighted down with stones, which answers the purpose equally well. The cableways were manufactured by the S. Flory Mfg. Co., Bangor, Pa.



TWIN TOWER CABLEWAYS FOR HAULING CRUSHED ROCK FROM THE QUARRY TO THE CRUSHERS AT THE VULCANITE PORTLAND CEMENT WORKS, VULCANITE, N. J. W. R. DUNN, SUPT.

CEMENT
... AND ...
ENGINEERING NEWS

Mar 13

CONCRETE BRIDGE OVER THE WABASH RIVER.
(Luten Design.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

OFFICE—1117 Schiller Building

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

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CHICAGO, MARCH, 1913

PRODUCTION OF PORTLAND CEMENT IN 1912.

The production of Portland cement in the United States in 1912 considerably exceeded 80 million barrels; some estimates are as high as 84 million barrels. This is another record to be proud of. It shows that the consumption of cement is still steadily increasing and that the propaganda made by cement manufacturers and advocates of concrete construction leads to continuous distribution of the knowledge of how to properly use cement and how to substitute cement for old-time methods of building.

The beginning of the year 1912 found the warehouses of the cement factories filled to capacity and the selling price of cement in many instances below th actual cost of production. Construction work all over the United States had been neglected or reduced to a minimum in the years prior to 1912. A prolonged general stagnation of all trades, owing to trust prosecution and poor crops, had left the country in a position in which a revival of trade on a large scale had to be foreseen, providing some of the unfavorable retarding features could be eliminated. The relief which followed was due, not to a cessation of the unfriendly action of the government towards corporations, as might have been reasonably expected, but to the promise of bountiful harvests which all at once opened the eyes of the railroad man and manufacturer alike to the fact that the country was hardly prepared to efficiently take care of the large crops and to turn them into articles of commerce.

In the spring of the year, therefore, as soon as an unusually abundant crop appeared to be assured all over the country, the large railroad companies and manufacturers gladly took advantage of the low price of building material and commenced operations on an unprecedented scale. As a result of this the stock houses were soon emptied, the demand for materials surpassed in time actual production and finally was far beyond the capacity of the plants. This was the first opportunity in years that cement manufacturers had to increase the price of cement. The year 1912 thus opened with prices as low as never before and closed with the highest prices reached in a long time and with good prospects for a long continuation of the prosperity which we are now enjoying.

As an illustration of the widespreading use of cement and of the enthusiasm existing among manufacturers we reprint the opinion of Mr. Morron, the president of the Atlas Portland Cement Co., who says:

"The cement industry is in a splendid condition. Prices are firm and I expect to see them go higher in the coming year. Projected construction work at the beginning of 1913 will require from 3,000,000 to 4,000,000 more barrels of cement than at the same time last year. Its use in road building is creating a constantly growing market. Some idea of the enormous consumption of cement for this purpose in the future may be gained from the fact that 2,500 to 3,000 barrels of material is required to each mile of road."

A SUMATRA PORTLAND CEMENT MILL.

A new Portland cement plant has been erected near Padang, Sumatra, and the old cement plant near Batavia has been abandoned. The Padang plant was designed, constructed and equipped by the firm of Amme, Giesecke & Konegen of Braunschweig, Germany, for a group of Dutch capitalists, who were interested by Mr. C. C. Lau, an architect who for 25 years has been a resident of the beautiful island of Sumatra.

Mr. Lau, having investigated the use of Portland cement in Sumatra and the neighboring island of Java, found that 500,000 barrels of cement were consumed yearly in Sumatra and 250,000 barrels in Java. The new plant has a daily capacity of 550 barrels of cement made from a high grade of limestone, practically free from magnesia, and two kinds of clay, one high in silica and the other low in silica.

The buildings are structural steel; the rotary kiln is 150 feet long by about 9 feet in diameter, powdered coal being used for fuel. The cement is packed and marketed in sheet steel casks.

LARGE PRODUCTION OF LIMESTONE.

Value of Output in 1911 Nearly $34,000,000—Greater Than Granite Industry.

More limestone is produced in the United States than any other kind of stone, not excepting granite, and its value is also greater.

The value of the limestone output in 1911, according to the United States Geological Survey, was $33,897,362, a decrease of $706,316 from the figures for 1910. The decrease in value was chiefly in limestone used for fluxing. These figures do not include the value of most of the stone that is burned into lime, nor a large quantity of limestone used in the manufacture of Portland cement.

The principal states that produced limestone in 1911 were, in rank of value, Pennsylvania, Ohio, Indiana, Illinois, New York and Missouri, each having an output of more than $2,000,000.

CORRECTION.

We failed to give credit to the Journal of the American Society of Engineering Contractors for the article in our December issue concerning Concrete Piles and Concrete Piling Equipment, by Maxwell W. Upson.

CRUSHED STONE PRICES.

Although business has shut down for the winter months in New York City, prices remain steady with very little trading. A few orders are being received for small quantities to finish work already started, and on these, price concessions are obtainable. No orders of size can be filled, as the exceptional fall business took all the available stone, and no consignments from the quarries will be made until spring. It is expected that business will open early in the spring, and a stiff demand experienced. Dealers are preparing for a record year. Prices are quoted at 85@95c. per cu. yd. for 1½-in. stone, 90c@$1 for 1¾-in. stone, and 90c.@$1 for screenings. These quotations are for full cargo lots of 500 cu. yd., delivered alongside of dock, New York.

CONCRETE ON THE FARM.

Because of the increasing demand of Iowa farmers for information about the use of cement in farm building, the extension department of Iowa State College is putting an expert into the field to lecture on this subject. It has made arrangements whereby H. E. Gaden, a man of wide experience, will give the months of December, January and February to educational work in Iowa. He will be available for lectures to any kind of a group of farmers at short courses, farmers' institutes or agricultural club meetings. Moreover, he will be available without a dollar of expense to the local institutes or clubs. Mr. Gaden will speak on various subjects, including "The Selection of Concreting Materials," "Proper Mixtures and Proportions of Concrete," "Concrete on the Modern Farm," "Concrete Farm Buildings," "Concrete Silos."

PLANT OF NOBLESVILLE MILLING CO., NOBLESVLLE, IND.

GOEMAN GRAIN AND ELEVATOR CO., MANSFIELD, OHIO.

THE MODERN GRAIN ELEVATOR.

When fall time pours the grain harvest across our continent, blocking traffic, choking railroads and holding up all regular trade, we admit the dependence of our country on its grain crop. Yet when this same crop is stored safely away, we promptly forget its very existence. And so the importance of the modern grain elevator is overlooked and, indeed, never even realized by the average citizen.

Since the first elevators built by Joseph of the many colored coat down to those of the present day, the greatest actual resources of practically every nation have been safeguarded in this way. With the present advancement along other lines, has come the modern concrete grain elevator, as far ahead of the steel one of ten or fifteen years ago as this was ahead of its bricks-without-straw Egyptian ancestor. Symmetrical and useful, it pleases the eye of every critic from the standpoint both of beauty and of utility.

At the top of the page on the left hand side is shown the new concrete grain storage plant erected by the Noblesville Milling Company at Noblesville, Ind. The construction was designed and executed by Jas. Stewart & Co., of Chicago and New York, and has a capacity of 350,000 bushels. 4,500 barrels of Lehigh Portland Cement were consumed in the work.

Particular attention should be paid to the smoothness of the outside surface, which indicates that when the forms were removed, the concrete remained intact, none adhering to the forms, resulting in a true monolithic structure, which reflects credit on the engineering skill of the contractors, a source of satisfaction to the owners, and another evidence of the high quality of our product.

Probably as model a plant as can be found is that shown on the right hand side of the page constructed by John S. Metcalf Co. of Chicago for the Goeman Grain and Elevator Co. at Mansfield, Ohio. Voegele Bros., agents for the Lehigh Portland Cement Company, Mansfield, O., furnished the cement, which amounted to 5,000 barrels. The photo at the top of the page shows well the arrangement of the concrete tanks, situated close to the tracks which bring in the grain.

CERESIT WATERPROOFING COMPANY.

The Ceresit Waterproofing Company, Clark and Adams streets, Chicago, announce that they have added to their staff a superintendent department, which department will be in charge of Mr. John J. Lyons, an able, competent and reliable man. It is the aim of this department to superintend any structure where engineers or architects desire to have a check on the contractor's waterproofing work. The Ceresit Company have been so frequently called upon for this service that they decided to inaugurate this department, which will be a valuable addition to the company. When superintendents are desired on the job, they are now in shape to give bond of guarantee.

Inspection of Surface Finishes For Concrete Work

By Jerome Cochran, C. E.*

The series of articles on the inspection of concrete work, of which this is the sixth, has been planned in opposition to the general assumption on the part of writers that standards or methods of construction have been long ago established and have become common knowledge. The first article on "Directions and Suggestions for the Inspection of Concrete Materials" appeared in this journal for Jan. 31, 1912; the second article on "Proportioning and Mixing Concrete" appeared on Feb. 7, 1912; the third article on "Inspection of Forms and Centering" appeared on Feb. 21, 1912; the fourth article on "Inspection of Steel Reinforcement" appeared on Feb. 28, 1912; and the fifth article. on "Inspection of Concreting" appeared on March 6, and 13, 1912. The following article relates to the inspection of concrete surface finishes. It will be followed by an article on water-proofing concrete work. (Engineering and Contracting, Chicago.)

Since the character of a concrete structure is judged largely by the appearance of the exterior, the finishing of such surfaces becomes very important. In some structures the appearance is the most important part of its design and construction. The manner of finishing surfaces must be governed by the size and class of the structure and the style of architectural decoration.

Imperfections in Exposed Concrete Surfaces.

Exposed concrete surfaces frequently present a patchy or unsightly appearance. In fact, it is not such an easy matter to secure a smooth surface of even grain and uniform color on a concrete structure. In a very large majority of cases, concrete structures are disfigured by a lack of uniformity in color, dark or light patches being conspicuously noticeable, while in other cases a streaky appearance is to be seen. The imperfections in the exposed surfaces of concrete are usually due to one or more of the ten well-known causes which may be summed up as follows:

1. Variations in the nature of the cement, sand and stone.
2. Lack of uniformity in the amounts of ingredients in each batch.
3. Insufficient mixing in any or all batches of concrete.
4. Lack of care in placing the concrete next the mold.
5. Lack of proper protection after placing concrete.
6. Efflorescence and discoloration of the surface.
7. Unsightly construction joints.
8. Imperfectly made forms.
9. Dirt on the forms.
10. Adhesion of forms.

Variations in Concrete Materials.—It is generally desirable that no change in the brand or quality of cement be made throughout the work. Different brands of cement may give different colors to the finished work. After a brand of cement has been accepted by the engineer and the contractor has purhased **the same, no other brand** should be permitted upon the work except by special permission of the engineer. The frequent changing of brands of cement is not only harmful to the work but also causes delay in testing. If more than one brand is used the colors must be such as not to show marked variations in appearance of the completed work. Only one brand should be used at the same time in any section of the work, the idea being to prevent mixing of brands, but two brands may be used in succession on the same day.

All sand used in concrete that will be exposed to view should be of a bright, uniform color. No sand should be used for the outside finish of any concrete which contains small particles of coal or lignite, although sand of this character may be used in the interior portion of heavy pieces of concrete work. The sand used for concrete surfaces and for mortar facings should be clean and sufficiently coarse. It should be free from all foreign matter, excepting loam or clay, which may be permitted, if the quantity does not exceed 3 per cent, and when these materials do not occur as a coating on the sand grains.

Broken stone or gravel for exposed concrete surfaces should be clean, and should be free from loam, clay, shale, and all perishable and foreign matter, or other improper substances. It should be washed, or screened, or both, if necessary, to remove such substances.

The water used in mixing the concrete should be free from iron or other impurities that tend to discolor the concrete.

Lack of Accurate Proportioning.—Lack of uniformity in the amounts of ingredients in each batch will cause imperfections in the exposed surfaces of concrete. The inspector should make certain that the specified proportions are accurately and uniformly adhered to.

Insufficient Mixing of Concrete.—Concrete should be thoroughly mixed and not allowed to look raw when deposited in the forms. If the concrete is not uniformly mixed, the surface will be irregularly colored and will contain pitted and honey-combed spots.

Lack of Care in Placing Concrete.—If the concrete is unmixed in the handling, the surface will be irregularly colored and will contain pitted and honeycombed spots.

Lack of Proper Protection of Concrete After Placing.—It is useless to make good concrete and place it properly, unless care is taken to protect it until it is hard enough to take care of itself. All exposed surfaces of finished and unfinished concrete should be kept constantly moist by sprinkling with clean water at short intervals. An excellent practice is to cover the surface with burlaps which may be kept saturated. This not only furnishes the necessary moisture, but protects the work from the direct rays of the sun. Rain falling on green work will make it rough and unsightly. Too rapid drying is apt to result in hair checking. These hair cracks may usually be prevented by keeping the surface wet for a considerable time.

For a spaded or mortar face finish, extreme care should be taken to protect the surface from danger of injury by frost. A thin scale about 1-16 inch in depth or more is apt to scale off from mortar facings which have been frozen. This, of course, is objectionable where a smooth finish is desired. In no case should fresh manure be placed over very green concrete to protect it from freezing, as it will spoil the surface of the concrete.

Efflorescence and Discoloration of the Surface.—If

*Engineering and Contracting, Chicago.

the concrete is not water-tight, and particularly if there is water or earth against the back of the concrete, efflorescence, or a white coating on the surface is likely to appear. Efflorescence results from diffusion of soluble sulphates of lime and alkalies to the surface. In other words, it is due to water percolating through the concrete and dissolving the soluble salts, which are left as a white, powdery substance on the surface when the water evaporates. Efflorescence tends to disappear in time, and rarely is sufficient in amount to cause any complaint.

Fresh manure should not be placed directly upon green concrete, as it is very apt to discolor the work and in some cases it is thought to have caused a slight disintegration of the surface of the concrete coming in contact with it. It is probable that only green concrete is injured by manure, as it has been used widely for stable floors, manure bins, etc., without any evidence of failure.

Unsightly Construction Joints.—All concrete work should be finished in its entirety before shutting down, but when this is not possible, the resulting joint should be formed where it will least impair the strength and appearance of the structure. If the placing of the concrete does not proceed continuously day and night, an unsightly line on the surface is likely to show where the two days' work joined. Care should be taken in the location of and in the manner of constructing the resulting joint if the concreting does not proceed continuously.

If the appearance of the finished face is of importance, special care must be exercised in order to prevent unsightly construction joints. Unsightly lines on the surface may be almost entirely eliminated by nailing a bevel or triangular strip against the form and finishing the day's work to the inner edge of this strip, thus producing a regular groove instead of the usual ragged division line. The writer has observed in a great many concrete structures that where one day's work joined that of another, unsightly construction joints could be very easily noticed, and in some cases these joints or lines were inclined, sloping at about the angle of repose of the wet concrete.

Imperfectly Made Forms.—Some of the precautions that must be taken to secure a good finish to the face of concrete work have already been mentioned in considering the forms (see Engng. & Contg., page 202, Feb. 21, 1912). If the joints between the individual boards of the forms are not close, the concrete will run between the boards and leave an ugly fin of lip on the exposed concrete. Swelling of lumber in forms will throw the face of the concrete out of plumb. The appearance of corners in the concrete may be improved by bevel strips within the forms. Knot holes in forms should be properly plugged with clay. Forms which are imperfectly constructed with different thicknesses of lumber used indiscriminately will not produce results which are compatible with ordinary conditions.

Dirt on the Forms.—Imperfection in the exposed surfaces of concrete may be caused by dirty forms. all dirt must be removed from the forms just before placing the concrete. All forms having been previously used should be thoroughly cleaned and prepared before being used again.

Adhesion of Concrete to Forms.—Concrete surfaces are frequently impaired by the adhesion of the surface to forms, owing to proper provision not being taken to prevent it. Many different methods are employed to prevent this adhesion as will be described later.

Finishing Surfaces.

Treatment of Concrete Surfaces.—There are various ways of correcting the above defects in exposed concrete surfaces or of securing a surface of better appearance than any left by the most perfect forms. These will next be considered, attention being given first to the methods of finishing a plain smooth surface and then to the methods of finishing that to secure a more ornamental surface. Except for the crudest work, all concrete surfaces should be treated.

Specifications for Surface Finish.—Specifications should be particular and explicit regarding the character and nicety of the surface finish required. If they are not, the inspector should learn from the engineer the quality of work he has in mind and should see that the contractor clearly understands the requirements.

Careful Inspection Needed.—Perfection of surface finish is a matter of attention and skillful workmanship, and the inspector has chiefly to watch the workmen.

Classes of Finish.—Finishes are of two classes: (1) Those in which the molding is so done that the finish is a part of the molding process; (2) those in which the molded surface is treated after the forms are removed. Faults in finishes of the first class must be prevented during molding by careful workmanship, for after the concrete has once set they can be remedied only by patching, which is generally very unsatisfactory, or by giving the whole surface one of the finishes belonging in the second class.

Types of Finish.—The above two general classes of finish for concrete may be further divided into the following types of methods of treatment:

(1) Plain, spaded, mortar face and troweled finishes; (2) Introduction of various ingredients into mortar or concrete; (3) Removal of surface in various ways; (4) Coating surfaces in various ways.

1. Plain, Spaded, Mortar and Troweled Finishes.

Plain Finish.—In some structures, where the appearance need not be regarded, the concrete can be left just as it comes from the forms, and if sufficient care has been taken in building the form work and placing the concrete, a very satisfactory finish will result. Care must be taken to avoid noticeable voids or stone pockets. Such treatment will result in sandy finish.

Dry Surface Finish.—A dry surface finish may be obtained by using a fine stone in the aggregate, mixing fairly dry, and not spading the concrete next to the forms.

Spaded Finish.—A good finish may be obtained by spading the concrete so as to bring the finer particles to the surface and force the larger particles back so they are not exposed. Where spading is faithfully done, an absolutely smooth surface is the result, whether the mixture be dry, medium, or very wet. In the case of a dry mixture, however, spading must be done with greatest care by experienced hands, in order to get uniform results; but with a medium or very wet mixture, it is very easy to obtain first class work. With a wet mixture spading is generally required only as an added precaution against the possibility of voids in the face of the work, and is really necessary in few cases.

Spading is best done with a special flat-bladed spade, having the blade perforated with holes or slots, which will screen back the stones and allow the mortar to pass and thus cover every stone. In narrow forms, instead of a spade a hoe may be used with the blade bent nearly in line with the handle. In spading, be careful to not pry with the spade, as this may spring the forms.

The method of spading is applicable only where forms are used. Necessarily, therefore, imperfections in these forms are to be carefully avoided. The

smoother the forms for this class of work the better will be the appearance of the work.

Mortar Face Finish.—If a mortar (or a granolithic) finish be specified, it may be obtained by placing the facing mortar and concrete backing at the same time and tamping them together. The certainty of a bond is in this manner assured. The facing material may be applied to the forms just ahead of the backing which is placed against and rammed into it. Another way to obtain a mortar finish is to place a loose board against the forms and tamp the concrete behind the board. The board is then removed and mortar run into the space that it occupied. Both methods have been successfully used, the second, however, being only applicable to comparatively dry concrete backing. Still another method of obtaining a smooth surface is to use a very wet concrete and throw it violently against the form, so that the aggregates rebound leaving in effect a mortar facing. This is, however, not to be recommended for fine work, as the forms are apt to be indented and the alignment impaired, but ordinarily this method is effective. A fourth method of using granolithic plates will be described later.

The mortar (or granolithic) finish should be maintained between the concrete and the face form in a thickness of about 1 inch. The inspector, of course, will be governed by the thickness given in the specifications or in the absence of such information, he will be governed by the engineer's decision in the matter, provided a mortar facing has been specified. Care must be taken that the concrete is rammed into and perfectly united with the mortar facing. The tamping or ramming, however, must not be so hard as to force pieces of stone through the facing, but just hard enough to bond thoroughly the facing and backing. The facing should show a smooth dense surface without pits or irregularities. This is most likely to be secured by thorough and systematic ramming.

Moldings, cornices, and other ornaments requiring mortar surface, should be formed by spreading plastic mortar upon the interior of finely constructed molds, just as the concrete is being laid. Mortar facing is not an easy job and requires workmen well experienced in this class of work.

Use of Granolithic Plates or Metal Facing Forms.—Possibly the best method of placing the facing material consists of what might be called a metal facing form or mold, constructed and used as follows:

The metal facing form or mold for placing the facing material on vertical surfaces generally consists of short lengths of iron plates 8 inches or 10 inches wide and about 6 feet long with three angle irons riveted to each plate, the size of the angle depending upon the thickness of the facing material specified (see Fig. 1). The metal facing form, however, may be any convenient width and length, depending on the nature and size of the work. An angle is placed at the center and one about 6 inches from each end of the plate, one edge of which is provided with handles and slightly flared to assist in depositing the material

The metal facing forms placed against the wall form with the handles up and the angles tight against the form. The space between it and the back of the wall is then filled with ordinary concrete backing of the specified proportions and the space between the metal form and the face form filled with facing material or mixture. Several of these metal forms may be used in line, with their ends lapping, and smaller lengths used to fill out a given length of wall form. Some difficulty may be experienced in carrying up a long line of this kind of concreting, especially at corners and at the junction of two sheets. It cannot be worked well in a narrow space.

The facing mortar should be kept slightly higher than the backing, to prevent the backing from running forward and disfiguring the front surface. Care must be taken that the metal facing form is not permitted to remain until initial set takes place, but be frequently jarred and raised slightly at short intervals to prevent the formation of shuts and seams and air spaces between mortar and the concrete. A trowel should be worked rapidly along the form, to remove air bubbles. Perfect success is secured only at the expense of great care. The facing mortar should be mixed wet and in small batches. Care must be taken to keep the forms perfectly clean or discolorations will be the inevitable result. A mortar facing shows the impress of small roughness on the form more readily than does concrete and particular care is necessary to secure a smooth surface on the form when a mortar facing is adopted. Even the grain of smoothly dressed wood is clearly impressed on the plastic material.

Proportions for Mortar Facing.—The facing mixture should not be of too rich proportions, in order that surface cracks may be avoided. As to the richness of the mortar facings, two parts sand by measure to one volume packed cement is usually sufficient, though a more glossy finish may be made if desired, by using equal parts of cement and sand. Good results, however, may be obtained with mortar composed of one part of cement to three parts of sand or screenings. The writer does not recommend mortar richer than a 1:2 mixture. It is better to avoid too great a variation between the richness of the mortar used for facing and that used in the body of the concrete. Too rich a mixture, or a surface mixture richer than the body concrete, will cause hair cracks.

Crushed marble screenings may be used if obtainable. These screenings or sand must not be too fine and should not exceed one-quarter inch. Limestone, granite or other stone screenings, different colored gravels and sand may be substituted for the marble chips.

Proportions for Granolithic Finish.—Granolithic is a facing or surfacing mortar composed of crushed granite and cement. A granolithic finish is more frequently used for foot walks and other places where resistance to wear is required, but may be used to surface walls, to line reservoirs, etc. If a gronlithic finish or surface is specified it may be made by placing against the face forms in advance of the body concrete or in case of horizontal surfaces, on top of the concrete base, a fine granolithic or facing concrete composed of one (1) part of Portland cement, one and one-half (1½) parts of coarse sand and two and one-half (2½) parts of pebbles or crushed granite or other approved stone as may be selected, screened to pass one-half inch and be retained on one-quarter-inch screen, thoroughly mixed and soft enough for full flushing. The granite is sometimes specified to contain no particles larger than three-eighths inches to 1 inch, and about one and one-half to two and one-half parts are used to one volume of Portland cement. Where both fine and coarse aggregates are used, in the mixture for the facing material a 1:1⅜:3, or 1:2:3 or even a 1:2:4 concrete with Portland cement, sand or stone screenings and crushed or screened gravel may be used.

Thickness of Mortar Finish.—The thickness of mortar facing employed in practice varies from one-half inch to 3 inches, but the usual practice is to make it 1 inch to 1½ inches thick. There is more danger, perhaps, of making the mortar facing too thick than too thin, thereby using too much cement.

Thickness of Granolithic Finish.—Granolithic finish when applied to a concrete base should be laid at the

same time as the concrete and should not be less than one-half inch thick for floors, 1 inch for sidewalks, and 2 inches for concrete pavements. Do not attempt to put a top coat less than 2 inches thick on a set concrete base, and even then be prepared to see unsightly shrinkage cracks on the surface.

Consistency of Mortar Facing.—The mortar facing for vertical surfaces should be mixed rather wet, since it must completely fill the metal facing mold, but care must be taken not to have it too thin or the stones from the concrete behind will be pushed through it during the subsequent filling and ramming. Mortar facing or finish on an exposed horizontal surface should be mixed to a plastic consistency and should be put on immediately after the concrete is deposited, care being taken that the surface of the concrete is clean.

Colored Facing Mortar.—A colored facing mortar may be obtained by using a suitable colored aggregate or by mixing coloring matter (mineral pigment) in the mortar. The first is the better, since it gives durable color and does not injure either the strength or durability of the mortar facing. Introduction of various ingredients into mortar or concrete will be discussed more fully below.

Spaded and Troweled Finish.—The coarse aggregate should be well pushed back from the face of the form to allow the mortar to flush to the surface. The forms must be stripped while the concrete is still green enough to be worked with a trowel. The surface should be troweled hard and smooth; but excessive troweling is likely to cause innumerable hair cracks in the finished surface. The scope of this method is limited to instances where the forms may be quickly removed, or removed in sections.

Wetting of Forms.—Forms must be properly treated either for a spaded or a mortar face finish. Concrete or mortar will adhere very strongly to forms if no special provision be taken to prevent it. Many different methods are employed to prevent this adhesion as will be described below.

All forms, if not coated with some oil or soap, should be thoroughly wetted before the concrete or mortar facing is poured. A sprinkling of the inside with a hose is not sufficient. The hose should be applied to both sides thoroughly until the boards take up no more moisture. When dry spots appear, wet them. If the wood is thoroughly wet with water before the concrete is laid, there is not much danger of concrete adhering. The great objection to water is that it is not always possible to thoroughly wet the forms and many times it is absolutely impossible to keep them wet without adding too much water to the concrete already poured. In freezing weather steam should be used in place of water to wrench the forms, immediately before placing the concrete.

Better results can generally be obtained with petrolatum cut down with three parts of hot kerosene and then applied with a brush. Linseed oil may also be used. Fatty oils should not be used, as they act on fresh concrete by disintegrating and discoloring it. Hot paraffine is sometimes used. The objections to oil are the expense, the weight of oil-soaked forms in handling and the liability of making the wall dirty. The oil that is to be used in oiling forms should be thick and heavy enough to act as a filler for the forms. Care, however, must be taken not to get this on too thick, as grease spots in concrete leave an unsightly appearance. If the walls require plastering, or any subsequent treatment, the oil skin, if any, must first be removed. The quality of oil known as "sludge" at the oil refineries, or its equal, is recommended. The oil should be thin enough to flow and fill the grain of the wood. Grain marks can be reduced to some extent by oiling the lumber with gloss oil and then throwing fine sand against the oiled surface with a bellows. A slight oiling of forms will result in great economy in saving of forming lumber. An excess of oil must not be used. The oil must be applied every time the forms are set. Don't oil form work after the steel reinforcement has been placed if by so doing the oil will come in contact with the metal.

Cheap soap boiled and applied hot to the forms gives very good results in preventing the adhesion of concrete to forms. Ordinary soft soap does not injure the surface or diminish the strength of the concrete, and should be used instead of oil or grease when the surfaces are to be whitewashed, grouted, or plastered, as the oil or grease is very apt to discolor the whitewashing or plastering. Soap should be thoroughly dissolved in water to the consistency of very thin paste and applied hot with brushes. The use of soap helps make a dense surface and does not interfere materially with subsequent treatment, provided the surface of the concrete is washed well with clean water before applying the whitewashing, plastering, etc. The objections to the use of soap are that it is expensive and is seldom applied properly.

Paper, unless it is oiled, will stick to the concrete and is hard to remove. The use of paper needs constant attention in order to secure satisfactory results. It is somewhat difficult to keep the paper absolutely smooth, so that the final surface does not show wrinkles. Unless the paper is very oily it will adhere to the concrete, necessitating that it be burned off so as to effect its removal, as a thorough soaking very seldom removes the paper entirely.

Edward Godfrey in his book on "Concrete," page 98, recommends that canvas painted with linseed oil be used as a cover for rough forms. It is waterproof and would therefore not absorb water from the concrete; it would also prevent the leaking of the liquid mortar that occurs at cracks or points in the wooden forms. It would probably be economical for the reason that it does not require planed boards in the forms and it could no doubt be used repeatedly. It would further help to keep the frost out of the concrete.

Making Good Defects in Surface Finish.—With all the means used to cover up the irregularities in forms and make the surface smooth there will be still some roughness not commercially avoidable. Some treatment of the surface after the removal of the forms is generally necessary. Noticeable voids, or stone pockets, should be filled with mortar mixed in the same proportions as the mortar in the concrete. Mortar for patching irregularities and pockets in concrete work, must contain the same proportions of cement and sand as the concrete, or it will set a different color. Corners may break off in removing the forms. These should also be plastered. A patchy surface may show that a bad patch of concrete was used or that the concrete has been mistreated during setting. It has been found, however, that patches appear even where care has been taken to use the same cement and a uniform mixture.

(To be continued.)

C. H. Petersen and E. H. Cornish have purchased the Luverne Concrete Company's plant at Luverne, Minn. The company is an old established one having enjoyed a large and steadily increasing business. They manufacture concrete products of all kinds.

A Big Irrigation Dam and Koppel Cars

Last year there was completed a tremendous irrigation dam of the Salmon River in Southern Idaho, a dam that contains 150,000 cubic yards of masonry and will hold water supply for 100,000 acres of land near the boundry between Idaho and Nevada. This Salmon River project is being developed by the Twin Falls Salmon River Land and Water Company, of which Mr. W. S. Kuhn of Pittsburg is president and Mr. D. C. MacWatters of Milner, Idaho, is general manager.

The reservoir formed by the dam will have a maximum area of 3,500 acres, while its storage capacity is 228,000 acre feet, this giving some idea of the size of the project.

In the spring of 1908 the preliminary work was begun by the Twin Falls Salmon River Land & Water Co., who are developing the project. From that time until a year later about one hundred men were employed, and when in the spring of 1909 excavation for foundation was commenced, the number of men was increased to two hundred. About June 1st, 1909, when the concreting was begun the force numbered 300 men, and in 1910 when the work was at its height an army of 430 men were at work every day on this tremendous project. Not until May of this year when the tunnel and open-cut were lined with concrete, the equipment dismantled and all in readiness, did the last of the force leave. Local conditions at the site of the dam required the installation of a large amount of construction plant, some of which had to be of special character to meet the conditions and the necessity of operating by electrical power.

Such work as this naturally demanded the most modern and highest form of equipment, and every care was taken by the engineers in charge to see that the most labor and time-saving equipment was at hand. A complete system of skips, portable track with cars, switches, etc., was furnished by the Orenstein, Arthur Koppel Company. This equipment was built in their plant at Koppel, Pa., and included cars of several different types, each adapted to handle most expeditiously the class of material for which it was designed. Needless to say these cars and railway equipment were more than a mere supplement in aiding this work; they were an absolute necessity.

A central concrete mixing plant was erected directly back of the east rim of the canyon, and a short distance downstream from that end of the top of the dam. This plant contained two units each consisting of rock crushers, a bucket-elevator, a revolving screen and a 1-yd mixer. Each crusher was belt driven by a 40-hp induction motor, which also drove the elevator and screen of each unit. The sand rolls and the bucket elevator that handles their output were driven by a 20-hp motor of the same type.

The materials were delivered to the plant and the concrete produced by the latter was handled in 1-yd Koppel steel dump cars, operating over 30-in. gauge tracks. The sand was brought from the deposit up the river to storage piles near the concrete plant in wagons. It was conveyed from these piles in cars for supplying the plant according to the demands. The spoil from the rock cut made in excavating the canal between the two tunnels was loaded into cars by traveling stiff-leg derricks and hauled directly to the crushers by electric mine locomotives supplied with power from an overhead trolley.

A track at the rear of the concrete plant is on a trestle which brings it high enough to permit the rock to be dumped from the cars into the crusher as it arrives. The output of each crusher is raised to the corresponding screen at the top of the plant by the bucket elevator of the unit. The fines from the screen are shunted to a roll through which they are passed to further reduce them. The output of this roll was raised by a separate elevator to a end bin at the top of the plant. The balance of the run of the crusher that will pass a screen having 25-in. holes falls into a second elevated bin provided for the stone supply. The natural sand also was sent through the crushers and raised to the bin provided for it. The cement is delivered by the traction engine trains to a storehouse adjacent to the mixing plant. The cement is loaded out of the house, as required at the mixer plant, to cars on a track extending from it to the latter. This track was on an incline that carries it up to a measuring floor over the mixers, the cars being hauled up the incline by a motor-driven hoist.

The materials are proportioned in a hopper over each of the mixers. The sand and stone are drawn to these hoppers through chutes in the respective bins, while the cement was added to each batch by hand. Each mixer was separately belt driven by a 30-hp induction motor in a tight shed which protects it from dust. A branch of the system of 30-in. gauge track extends along in front of the two mixers, so the latter can discharge into dump cars or into buckets on flat cars operating to any point where the tracks are laid.

A counterbalanced double-cage hoist, inclined at an angle of 14 degrees from the vertical was erected on the side of the canyon adjacent to the mixing plant to lower the cars of concrete to the level of tracks on trestles extending across at the elevation at which operations were in progress on the dam. This elevator was built with a landing platform at the top arranged with automatic blocks so a car on either track cannot be pushed until the corresponding cage had reached the exact level of the track. The two cages are 6x8 ft. in plan and have a capacity of 5 tons. Their arrangement is such that when one of them is descending loaded, it will pull the other one up empty. In order to provide for unbalancing loads, however, a hoist on the elevator is geared to a 40-hp. motor so provision is made for any operating conditions that may arise. The cages are arranged to stop at the level at which tracks extending across the dam are laid, in order that the cars may be shunted directly to these tracks.

Placing of the concrete was started at the west end of the dam as soon as the foundation at that end had been prepared. A jaw crusher, with screens storage bins, and a ½-yd. concrete mixer was erected just up stream from the excavation. A large pile of spoil from the outlet tunnel had accumulated at this point where it could be passed through the temporary concrete plant by gravity. The concrete produced by the mixer in this location was delivered in the cars on tracks laid across the channel to within the range of the derricks at the west end of the dam. It was dumped directly to place from the car or the latter were swung around by the derrick.

Meanwhile a trestle was erected across the canyon on the axis of the dam bringing it to a height of 47 feet above the lowest point of the bed rock foundation. A single track of this trestle extended from two

branches at the foot of the inclined elevator across to the opposite side of the dam. Early in the work the concrete was delivered in 1-yd. buckets, which were lowered down into the canyon on flat cars by the hoist and then shunted over the trestle track to within the range of the derricks. Later the 1-yd steel dump cars were used, hoppers being swung from the side of the trestle to carry chutes through which the concrete could be dropped from them directly to place. The chutes were made of 12 in. galvanized pipe in short sections, which had telescoping joints so their lengths could be altered according to the height of masonry. The chutes were also sufficiently flexible to permit their lower ends to move through a considerable range.

The canal between the two outlet tunnels involved the removal of approximately 86,000 cubic yards of rock, all of which had to be blasted. The rock was loaded by hand into skips which were hoisted by two traveling stiff leg derricks and dumped directly into 2.5 yd. Koppel steel cars for delivery to the concrete plant. A 30-in. gauge track was laid along the edge of the excavation for the derricks, which were moved on it by their own power.

The engineering department of the Orenstein-Arthur Koppel Company have made a marked success of designing special cars for special purposes, and the wonderful utility of these cars in forwarding the work of this gigantic Salmon River project has been a well earned reward for their efforts.

WATERPROOF CONCRETE.

Some experiments on impervious concrete were made at Husum, Germany, recently in connection with preparations for the construction of a new lighthouse. Various mixtures of cement and fine dune sand in ratios 1:1 up to 1:6 and mixtures of 1:3 with the addition of various waterproofing material, such as soft soap, oil and patented mixtures were prepared and were molded into pot-shaped vessels about 15 inches high, with 2½-inch walls. When these pots had set, some of them were filled with water, others (empty) were set into water; and the density of the walls was judged by noting the time required to empty or fill, the water acting under a maximum head of about 10 inches. The experiments showed that a satisfactory degree of imperviousness was not reached, since in every test the vessels filled or emptied within an hour. The relative success of the richer mixtures then induced tests of rich rubbed surfacing. To this end the surfaces were first wet, then thickly coated with cement paste, and with a soft brush the cement paste was then rubbed into the surface of the concrete. Repeating this procedure several times until the pores were closed, a very satisfactory imperviousness was reached, the pressure tests (as above) continued for three days showing no water passing through the walls of the pots. On the basis of these tests it was decided to build the lighthouse sub-structure of 1:3 mixture which surface made impervious by the grout-rubbing process as used in the experiments.

THE MECHANICS OF BUILDING CONSTRUCTION.

A book written by H. Adams, dealing with the mechanical principles of building construction, containing 590 diagrams fully illustrating every phase of design. Price, $2.00. Sent upon receipt of money order by Cement & Engineering News, Schiller Bldg.,

COAL DUST DRYING.

The following extract is taken from the January issue of "Quarterly of the National Fire Protection Association," Hartford, Conn., Henry A. Fiske, editor, regarding the hazards of coal drying. It is of great importance to every manufacturer of Portland cement, and should be most carefully considered, writes the C. O. Bartlett & Snow Co., Cleveland, O. The people of the United States are demanding more than ever before that more attention be given to the safety of men employed in handling coal products. It is a very serious matter for any man to have resting upon his shoulders the responsibility, either directly or indirectly, of the killing of his fellowmen.

"Under no circumstances is it recommended that the products of combustion be allowed to come in contact with the coal to be dried. Some recommend this and I am informed that quite a number of plants are thus arranged. Already there have been quite a number of accidents from this cause in which lives were lost.

A characteristic coal mill explosion (March 2, 1903—Editors.) in New Village, N. J., caused by the ignition of pulverized coal at the Edison plant, killed six men and burned five others, perhaps fatally, besides injuring a score of others and destroying the coal building. It is supposed that the pulverized coal in bin fired spontaneously and some of the burning fuel was carried by the conveyor (automatic) into the blower house. The atmosphere of the blower house being charged with coal dust an explosion was the result.

On August 19, 1900, an explosion in the plant of the Nazareth Cement Co., Nazareth, Pa., caused a loss of $16,000, while on November 26 of the same year $40,000 damage was done to the Martin's Creek Portland Cement Co. (then known as William Krause & Sons), Martin's Creek, Pa. The Dexter Portland Cement Co., Nazareth, Pa., and the Alpha Portland Cement Mill No. 1, Alpha, N. J., had similar experiences the same year.

I learn that the laws of England do not allow any coal dryers where the products of fire come in contact with coal to be dried, and engineers in that country had already predicted trouble with disastrous results in this country before the above mentioned accidents occurred."

We have always advocated and practiced that the products of the fire should never come in contact with the coal dust while it is being dried on account of the liability of explosion. Can there be any better proof of this under high heavens than the above extract by Mr. Henry A. Fiske?

BRADLEY PULVERIZER.

The Bradley Pulverizer Company, Boston, Mass., have sold a Bradley three-roll mill to the Adams & Duford Company, of Chaumont, N. Y., for the purpose of pulverizing limestone for agricultural purposes. The above people met with a severe fire loss on January 15th, which completely destroyed their large limestone plant. It is their expectation to be running again within three weeks.

The Bradley three-roll mill is especially adapted to the pulverizing of limestone as it is a large capacity pulverizer, giving a very fine product without use of auxiliary screens and with a low cost of up-keep.

EUROPEAN PRACTICE IN TESTING ROAD MATERIALS.

The desirability of adopting an international standard of methods for testing road materials has been for some time under consideration by the Executive Bureau of the International Road Congress and the International Association for Testing Materials, and as a preliminary step in this direction, the latter association has collected information regarding important methods in use in a number of countries. This information relating to Germany, Austria, Belgium, Denmark, Holland, Hungary and Norway was presented by M. A. Mesnager, of Paris, general referee in the matter, in a report to the recent congress of the International Association for Testing Materials. It is sought to obtain a basis for standard tests of paving stones, road metal, wood, asphalts, slabs, bricks and slag bricks, artificial stones, tar, bitumen and sands.

The divisions of the report relating to the various countries differ materially as to point of view and are unequally developed, but they show a universal interest and realization of the need of standard methods of testing. There is a considerable diversity in testing methods, the reports of some countries, notably Germany, showing a number of physical laboratory tests, while others point to the determination of values of materials largely through service tests. The latter plan is extensively followed in Budapest, which is the only Hungarian practice presented, and also with stone in Denmark, Norway and Belgium. Some of the principal physical tests are applied in several countries, though the methods differ in detail, while other special tests are made only in individual cases.

A microscopical examination of rocks to ascertain the constituents and geological characteristics is included in the tests of Germany and Austria. Absorption tests are also made in both of these countries, this being done in Austria in connection with the crushing test, which is made on both dry and saturated stone. In Germany, the absorption is determined by drying a specimen until it is of constant weight and then immersing it until the weight is again constant. Its capacity for releasing the absorbed water is then determined by storage in air until the dry weight returns to a constant. In this test the change in dimension of cubes, tangentially, radially and longitudinally with reference to the axis, is observed after immersion and redrying.

Impermeability of a road material is determined in Germany by cementing graduated glass tubes, 3.5 cm. in diameter, on five dried test pieces, so that the joint is watertight, and filling the tubes to a depth of 25 cm. with water. The permeability is noted as regards soaking or dropping and also as to the the quantity of water absorbed.

Resistance to frost is tested in Germany and Austria, the German method being to saturate specimens with water and then to subject them 25 times to alternate freezing in a cooled chamber and thawing in water at room temperature. After each freezing and thawing, they are weighed and the external condition noted. In the Austrian test, the coefficient of saturation is given special consideration in connection with frost resistance. This coefficient is determined by dividing the factor of gradual absorption of water by that of absorption in a compressor, under heavy pressure preceded by evacuation.

Crushing strength tests are regularly applied in Germany, Austria, Belgium and the Netherlands. In Germany, cubical specimens 3 to 5 cm. on a side are used, the test being made in the dry or saturated state, or when saturated after 25 freezings. For testing rammed asphalt, 7.1-cm. cubes are rammed in molds, and for poured asphalt, similar cubes are cast, the specimens being allowed a fixed time to harden. In Austria, also, crushing tests are made on dry, wet and frozen stone, and the coefficient of softening is found at the same time by observing the ratio of the crushing strength when wet to that when dry. In Belgium, sandstone setts are tested for crushing by the use of 7-cm. cubes. Porphyry is not tested, since it comes from two quarries, the products of which are known in service. Broken stone comes chiefly from these quarries and is examined physically but not tested in machines.

Stone for setts and macadam in Denmark also comes from known quarries and is therefore not tested. The same practice is followed in the Nethelands with stone, certain quarries being specified. With some stones, crushing tests are at times required and similar tests are prescribed for bricks, a certain load per unit of area being specified, varying with the nature of the material.

Resistance of paving materials to wear is mechanically tested in Germany, Austria, Belgium and the Netherlands. In Germany grinding, sand blast and drum tests are employed. The former consists of subjecting a dried test piece to grinding in a Baushinger machine under a load such that the pressure per unit of contact is 0.6 kg. per square centimeter. The number of revolutions is so taken that the length of active grinding surface is 608 meters and the velocity 4.69 meters per second. For every 22 revolutions of the disk, or 20 times during the test, 20 grams of No. 3 Naxos emery is added, the detritus being removed before each application. The loss of weight in this test divided by the density is taken as the attrition value of the material. A grinding test is also applied in Austria and one on flagstones in the Netherlands. In the latter instance, two test pieces, 6 cm. square, are subjected to a test similar to the above, the average allowable wear being fixed at 0.5 cm.

The German sand blast method provides for the exposure of dried specimens for 2 minutes to a blast operated by steam at a pressure of 3 atmospheres. The test piece is moved slowly to and fro by gearing, so as to expose uniformly an area 6 cm. in diameter. The sand blast is also applied in Austria.

The drum test is performed in Germany by the Deval method, using several drums. The test material is washed, subjected to about 10,000 revolutions, washed again, and the screenings weighed to show the loss by wear. In a similar test in the Netherlands, macadam stone is placed in ball mill, without balls, rotated for an hour at 45 revolutions per minute and the loss ascertained. In a second test, following the above, two steel balls, 8 cm. in diameter, are used and the loss again calculated. The mean of four tests is taken.

Impacted resistance is measured in German and Austrian tests. In Germany, pear-shaped iron tups of various weights are dropped from measured heights on the center of specimens which rest firmly in a bed of sand. The impact force which just suffices to rupture the specimen at one blow is ascertained and the method of collapse noted. Tenacity is determined by the Foppl method, using impact tests similar to the above on cubes 3.5 cm. on a side. The specimen is subjected to several blows, the successive blows being one, two and three times the initial height and so forth to rupture, the force expended up to the time of rupture being the measure of resistance of the material. Tenacity is also determined by impact tests in Austria.

Flagstones are tested for bending in Germany and the Netherlands. In the former case the test piece is supported freely on steel knife-edges, ribs of cement

being affixed to the bearing surfaces and the center where necessary. The pressure is applied at the center through a steel knife-edge or round wooden rod. In the Netherlands the knife-edges are specified to be 20 cm. apart, and the test is made on both dry and saturated specimens. The mean of six tests is taken.

Hardness of stones is determined in Germany by Moh's scale, and density, specific gravity, compactness and porosity by weighing tests in the laboratory.

Gravel is tested for clay content in Denmark by levigation with water, but no standard proportion of clay is specified. In Norway, such road materials as macadam and stone setts are generally selected in accordance with experience, except in some cities where there are specified tests. No general coefficient of quality have been established there..

The service tests which are made in Budapest, Hungary, on experimental strips of road are required of all roadmaking materials. Persons desiring to present a stone for use must first make an application accompanied by an official laboratory certificate of hardness, and must then bear the cost of laying the experimental strip, as well as an adjacent one of some known material. If the material turns out well, the contractor is repaid. Different grades of stone are tried on streets of traffic density corresponding as nearly as possible to the service for which they are suited. These strips of experimental pavement are kept under observation for a term of about 5 years. Both stone blocks and macadam are tested in this way. All material used in regular service is then subjected to close inspection as to size and, in the case of macadam, freedom from chippings and foreign matter.

COLOSSEUS CEMENT PATENTS VOID.

Sometime ago the German Patent Office cancelled the patents issued to the Hercynia Cement works, Germany, for a method of cement manufacture called the "Colosseus" process. According to the patent, the process consisted in a "method to produce a cement by treating red-hot blast furnace slag with alkaline solutions, characterized by the fact that solutions of soluble lime, aluminum or magnesium salts are sprayed into the slag or slag powder and sprayed in such a manner that the solvent evaporates when coming in contact with the slag." This was a modification of the "Passow" process, in which red-hot slag was cooled through some cooling agent like air, water or steam, and after grinding gave a cement-like slag dust which had the property of setting. The fear that the new slag cement would drive out Portland cement proved to be baseless, as Passow himself soon found that the setting process noticed in the slag was due to the formation of two elements in the slag, one of which contained lime compounds which were needed by the other element for setting. Experience proved that the compounds necessary for setting were so small in quantity that the carbon dioxide in the air soon changed them into carbonate of lime, which spoiled the so-called cement after a few weeks' storage. After recognizing the failure of this process, Passow added a little Portland cement to the slag, which already contained considerable quantities of hydrate of lime. The new slag cement has been used for many years and is manufactured by this method by several German works.

Dr. Colosseus, a former assistant of Passow, believed that the addition of small quantities of Portland cement was unnecessary and started out to make cement by the process noted above without the use of cement. It is practically the Passow process with a salt solution substituted in the spraying for Passow's pure water or air. The Hercynia works took up the Colosseus patent, and made cement by this process. Soon, however, the same fact noticed by Passow was apparent in this case also, and cement began to come back from the customers with complaints of poor quality. After a thorough investigation of the Colosseus process it was modified somewhat, and a satisfactory cement produced. The corrections consisted in adding all sorts of compounds like hydrate of lime, gypsum, etc., and finally Portland cement, although this last addition was kept secret. But the elimination of the use of the Portland cement was the core of the Colosseus process, and the employment of Portland cement meant that the Colosseus process was not used, but rather a modified Passow process. The value of the patent was therefore nil, for any slag cement in which the slag was powdered and cooled by water, air or other means gave exactly the same result as the Colosseus process using the salt solutions.

To save appearances and incidentally the patent rights, the Hercynia works stated that the Portland cement was added merely to regulate the time of setting or as a medium to balance the qualities of various forms of slag. The real reason was still kept from the public, and all efforts of Passow, who made microscopic and chemical analyses, and tried to force the company to make the open statement acknowledging the real reason for the use of Portland cement was received by the Hercynia works and Dr. Colosseus with silence. In spite of the warning against this so-called Colosseus process, many companies were formed all over the world, and the quarrel as to the details of the process and the theories lasted until 1911, when the German Patent Office took a hand in the matter and decided to give a final test to the process, having a number of experts as judges. Among these both Dr. Passow and Dr. Colosseus attended, and the results, which were unfavorable to the Colosseus process, caused the Patent Office to cancel the patents issued to the Hercynia works and to Dr. Colosseus, and known as the Colosseus Process.—Translated from Baumaterialien Market.

SACK SENSE.

A Story of Ten Cents.

A sack that carries its contents from the mills of the manufacturer to the ultimate purchaser, that is properly untied, that is kept clean and dry, that is not used as a covering for concrete nor as a tool-chest, nor as a knee, feet or back protector, nor as a hod-pad nor as a shoe cleaner and that, having thus once served its legitimate purpose, finds its way back to the mills of the manufacturer within a reasonable length of time, such a sack is again available for use and is worth the sum of ten cents; BUT

A sack that, upon its arrival at the job is opened with a shovel, that is used to plug holes in the water barrel, that is used as a sun-shade for concrete in summer and as an overcoat in winter, that likewise serves as a workman's apron, tool receptacle, and that is commissioned for other miscellaneous purposes just because it is handy, that becomes dirty, wet and even torn in places, the value of such a sack has reached the zero mark and consequently, the needless labor of collecting, sorting, counting, bundling and tying sacks so improperly used, should be avoided and the freight on their return saved by the man who purchased and used the cement.

A SUBSCRIBER.

Doolittle and Wilcox, Limited, Crushing Plant

The demand for crushed stone for all purposes has increased enormously during the past few years. This increase has been very marked in Canada, which is building extensively, and building permanently of concrete. The good roads movement is also increasing the use of crushed stone in Canada and the iron and steel industry which is there very active, demands a large amount of this material as a flux.

To meet this demand the quarry operators have been increasing the capacities of their plants and many new plants have been erected. Notable among these is the plant recently erected by Doolittle & Wilcox, Limited, at their Dundas (Ontario) Quarry. This plant embodies the latest ideas in rock crushing and screening machinery and it is equipped with the best machinery obtainable for the purpose. The arrangements for meeting the demands of the trade are most complete and many novel features are included in the design.

THE SCREENING PLANT. NOTE THE CRUSHING PLANT AT THE UPPER RIGHT.

This quarry has been operated by the present owners for about six years. The property contains 150 acres with an average depth of rock of 200 feet, about 40 feet of which has already been quarried. With the construction of the new plant, the old plant has been abandoned and heavier machinery substituted with a rearrangement of the crushers.

The new plant is located on the brow of the mountain or ridge which forms the limestone property. In this way the force of gravity is utilized to a great extent in the passing of the material between the crushers and screens.

The main breaker is a Mammouth McCully Crusher, which is the largest size of gyratory crusher made, having an opening of 42 inches by 11 feet between head and concaves, weighing 225 tons and requiring a 250-horsepower motor. The stone is discharged from this crusher over two four-inch grizzlies to a No. 7½ and No. 8 Austin Crusher set on each side of the Mammouth. These crushers reduce the stone to about two inches and also act as auxiliaries to the larger crusher. The fine material received from the first screening is delivered from the grizzlies to hoppers and is not passed through the fine crushers.

In this way, the small crushers are saved the load incident to recrushing the entire output of the Mammouth and the capacity of the plant is consequently increased.

The crushers are all set on reinforced concrete foundations in a pocket excavated in the solid rock. Individual motors are used for the three crushers aggregating 375 horsepower. In order to install the heavy crushers in this place, it was necessary for a 50-ton crane to be erected for the purpose of handling the heavy machinery.

Two 30-inch Belt Conveyors, 210 feet centers, receive material from the two grizzlies and from the two small crushers. These lead through a galley from the crusher building to the screen building and deliver into two hoppers above the screens. These hoppers each feed a pair of Revolving Screens each 48 inches in diameter by 28 feet long, and provided with seven-foot dust jackets. These screens are of particularly heavy construction built especially for this plant. The coarse material from the screens passes directly to the bins below but the fine material is further separated by a counterbalanced shaking screen. This screen is a most important feature in the plant and it will be noted that the majority of modern plants are being supplied with these balanced screens. The capacity is very great for the screening area and it is also the only screen that can successfully separate fine crushed stone from the clay and dirt.

In order to provide for any amount of the fine product a recrushing building has been erected in which two sets of crushing rolls were installed. Rock from the course material hoppers may be delivered to these rolls which discharge in turn to a pair of 14-inch bucket elevators, 86-feet centers, which elevate the recrushed stone to the large screens. In this way the fine material passes again through the rotary and

shaking screens and thence into the fine material bins. This arrangement allows for the entire product of the plant to be crushed to sizes to suit the demand at any time, and there, thus, becomes no difficulty in selling the entire output.

It will be noticed that the plant is arranged in duplicate and it is thus possible to make repairs without shutting down the whole plant. From the small crushers to the final screening two sets of equipment are used—crushers, conveyors and screens—and as a substitute for the single large crusher the small crushers are able to take the product of the quarry.

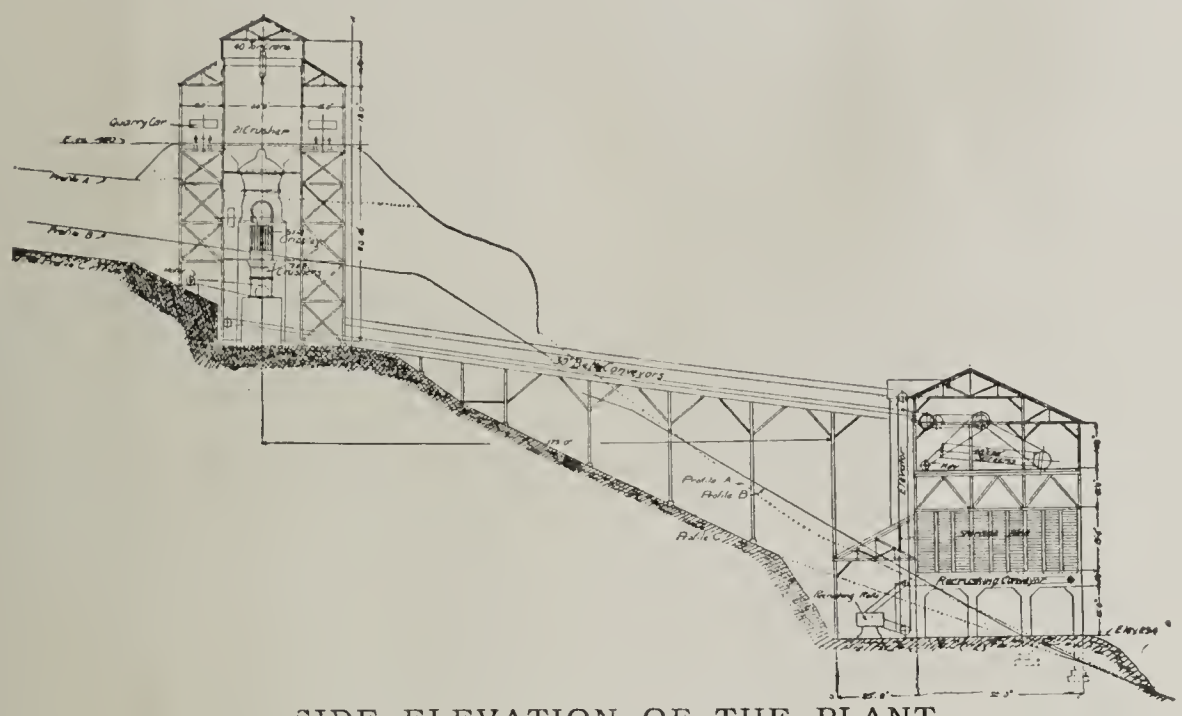
Power for the operation of the plant is obtained from the Cataract Power Company over a 10,000 volt line which is reduced to 4-0 volts for the plant and to 200 volts for the quarry machinery. The rock is drilled in the quarry by well drilling machines and blasted with dynamite. Steam shovels load the broken stone into four-yard dump cars in which it is delivered to the crushers. They have one, 91 Model Marion steam

ONE OF THE 30-INCH CONVEYORS.

shovel manufactured by the Marion Steam Shovel Co., Marion, Ohio and two Thew automatic electric shovels.

The capacity of this plant for quarrying and crushing is about 4,000 cubic yards of rock per day of ten hours. The rock is a hard, close grained dolomitic limestone of very low silica content. This latter property makes the stone very desirable as a flux for blast furnaces, and the hardness and small absorption makes it an excellent stone for road finishing.

Dundas is situated on the main line of the Grand Trunk and ample shipping facilities are thus provided. Besides a large local business in Toronto a great deal of the stone is used by blast furnaces, it being bought



SIDE ELEVATION OF THE PLANT.

in great quantities by the Steel Company of Canada, in Hamilton, and the Lackawanna Steel Company, in Buffalo. To supply this demand the quarries are operated throughout the year.

Stephens-Adamson Mfg. Co. furnished all the conveying, elevating and screening machinery besides the necessary gates, etc., for the bins.

The J. C. Buckbee Company were the engineers in charge of the work.

GRAVEL RATE HEARING ON.

Testimony concerning the gravel rate between Houston and Amtiorage, La., and intermediate points apropos of the raising of the rate by the Frisco Railroad Company was heard in the United States district in Houston, Texas, by Examiner Eddy, representing the interstate commerce commission.

The complaint that the increase in gravel rates would make the shipment of gravel to Houston and intermediate points prohibitive was made by the Tyoa Sand and Gravel Company and half a dozen other firms that ship gravel from Louisiana over the Frisco line.

The rate from Amtiorage to Houston is 4½ cents on the 100 pounds and the raise, of which notice has been given by the railroad company to the interstate commerce commission, if of 2 cents from Amtiorage and of ½ cent from Kinder and all intermediate points. Pending the finding of the commission the new rate has been suspended and the old one is operative.

Owing to the large amount of gravel from the Louisiana beds that is hauled into Houston over this line, the decision of the interstate commerce commission on the protest against increase of rate is being watched closely in the building circles.

WINS $22,000 DAMAGE CASE.

A verdict for $22,000, the largest ever returned in a personal injury suit before the federal court at Davenport, Iowa, was affirmed yesterday by the appellate federal court in St. Paul in the case of Edward Kohl against Dolez Brothers. Kohl was maimed for life in a dynamite blast at Linwood quarries near Davenport, Iowa, two years ago.

Worcester Sand-Lime Brick Co's. New Plant

A little over eleven months ago two men stepped off an express train at Union Station. They were well dressed, energetic, and had all the ear marks of the successful business man. That they were strangers to the city of Worcester was apparent, for they bowed neither to the right nor to the left to groups of Worcester business men, well known in all parts of the city, who happened to be at the station platform waiting for a train.

These two men were Frank H. Hunter and D. E. Rogers of Hartford, Conn., vice-president and treasurer, respectively, of the Connecticut Engineering & Construction Co. Both were well known in their own community and among business associates of their own and other states, but on that day they were without an acquaintance in this city and had with them as their single credential a letter of introduction from banking men of Hartford to bankers in Worcester.

They did, however, possess a real valuable piece of knowledge about Worcester, something if it did not make them permanent residents of the city would at least tie them up to this thriving community as adopted sons for some months every year thereafter. That knowledge, which by the way they have since imparted and claim has been confirmed by Worcester business men, can be summed up in a single sentence —Worcester presented an unusually attractive field for the establishment of an extensive plant for the manufacture of brick.

They were so certain of that one particular that they sought no personal letter of introduction to the mass of business interests of the city. They had experts go over the field thoroughly before they decided to locate here. They knew that millions of brick were being shipped into Worcester annually. They had ascertained that there was not a real large brick making plant within forty miles of the Heart of the Commonwealth, and from previous experience they reasoned that Worcester builders would prefer to buy their brick in the home market, rather than pay the extra charges of freight shipments which they had faced in years gone by. Further more, they were going to make the comparatively new process product —the sand-lime brick—which they claim has many superior qualities over the old-fashioned product commonly known as "red brick."

With these various facts at their command, and possessed of an abundance of New England grit and perseverance, they commenced the task of picking a suitable site for a plant, and organizing a sand-lime brick company here in Worcester.

How well they succeeded is apparent, for there stands today, ready for business, on the site of the old Warren Tannery at West Auburn, six miles from City Hall, a modern brick making plant, with a capacity of 40,000 bricks in ten hours, representing an initial outlay of more than $60,000, and back of which is a $150,000 Massachusetts corporation, The Worcester Sand-Lime Brick Company, a majority of whose stockholders and officers are Worcester business men.

This, in brief, is the history of the organizing of the Worcester Sand-Lime Brick Company and while many of the details would prove interesting reading if space permitted, the picking of the Warren Tannery and adjacent property as a site is too interesting to let go by without telling the whole story.

It sounds a lot like a tale of the Forty-Niners and prospecting in the days of the gold craze in the West, and Mr. Hunter and Mr. Rogers attribute what they term their "luckiest strike" to the same goddess of fortune which directed the grizzled miners to a California bonanza. It came a few weeks after they had located and got acquainted in Worcester, and at the close of a day of travel about the sorrounding country, looking over possible sites with an abundance of sand, which had been suggested to them by Worcester men who knew the country for miles around Worcester. None of the sites, however, had been entirely satisfactory. Some had possessed the necessary quality of sand but were too far removed from a main highway or railroad. Others better situated did not show the proper quality of sand.

Returning to Worcester on the Worcester & Southbridge branch of the Consolidated Street Railway the two prospectors happened to note the Warren Tannery as the electric car went over the high railroad bridge a few hundred feet away. From the conductor they learned that the tannery had ceased business, and out of curiosity more than anything else they alighted at the nearest stop and proceeded to look over the property. Naturally, the first thing they sought was sand, and they found it. It was there in such quantity that they couldn't miss it. Everywhere sods had been removed the sand was ankle deep and of that clean kind which showed, even without analysis, a high percentage of silica, a fundamental factor in the manufacture of sand-lime brick.

The next morning, bright and early, the two prospectors went over the ground again, taking samples here and there in the many acres about the old tannery

Tests of their samples more than confirmed their predictions. The sand averaged 97 per cent silicate, the best analysis encountered in New England, and almost without precedent in the East. It was absolutely ideal for the purpose.

Further tests, all made quietly, by the way, showed the sand to run 30 feet deep in many places about the property, deposits which began back thousands of years ago when the glaciated area of this globe commenced to recede toward the Arctic Circles.

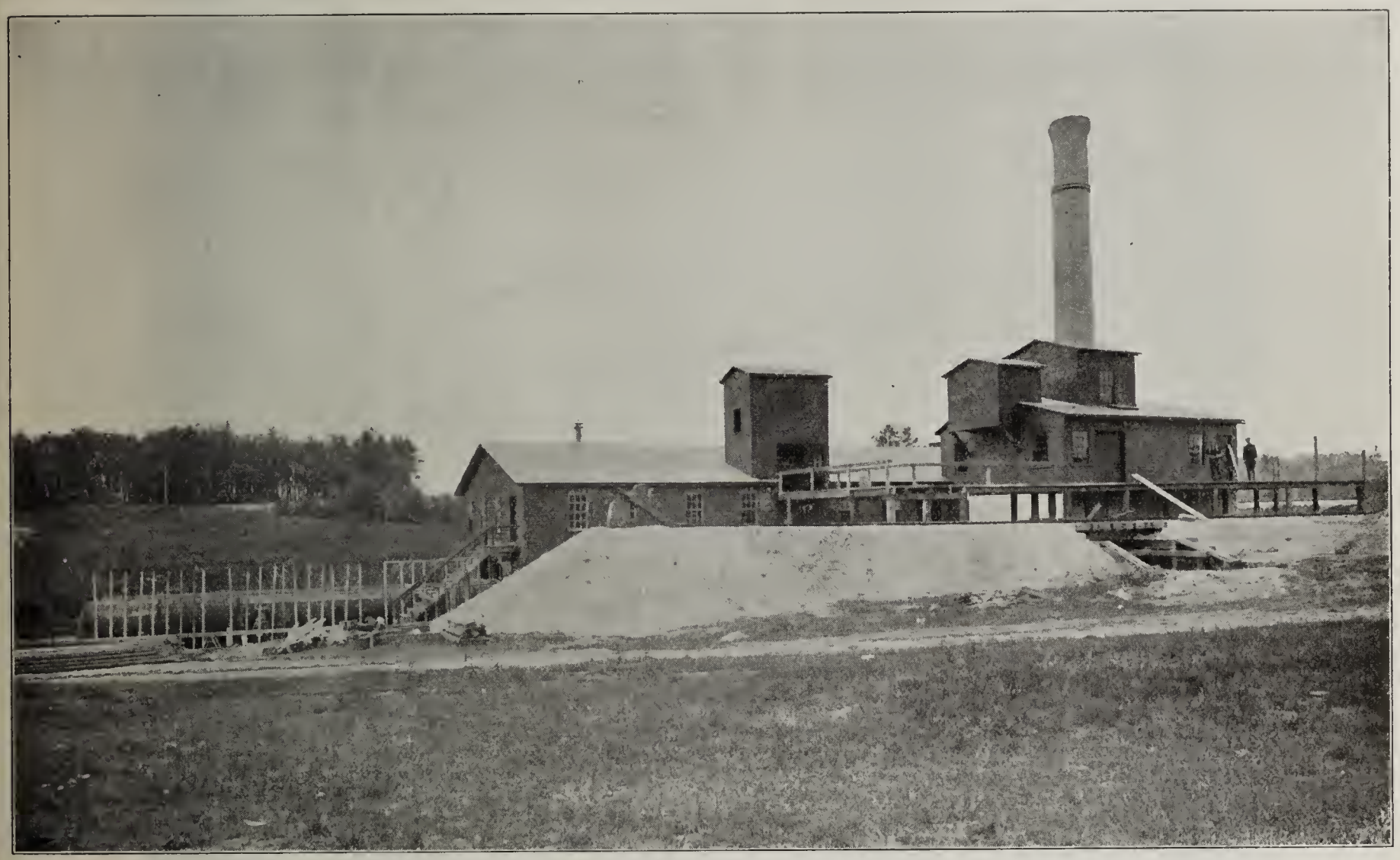
The quality of the sand alone would have been enough to have decided the experts on the Warren Tannery location, but with the property bounded on one side by the Webster branch of the Boston & Albany Railroad, on another by a street railway line, and still another side by a State highway direct to the city of Worcester six miles away, a substantial factory building already on the site, and a brook for a water supply which has never run dry, going through the property, it was their "luckiest strike."

To find such a valuable bit of property adapted for their own business was one thing. To tie it up with options was another—a bit of work which called to the limit their past experience and business ability. They succeeded in doing it in an incredibly short time. It was a matter of days instead of weeks when they had seven owners of adjoining property in the neighborhood agreed to the disposal of their long unproductive farm and scrub growth land at an excellent price for such common looking property, but for sand-lime brick purposes the price was extremely reasonable. The promoters of the business didn't want to raise enough subscriptions in Worcester to enable them to pay spot cash for the property. Long before the options expired they had purchased, in the name of the Worcester Sand-Lime Brick Company, the twenty-five acres they had bound up, with cold cash. They took the risk of the enterprise falling through, though neither of them called it a risk nor entertained any fear of losing their greenbacks.

From that time on the proposed business went

steadily forward. Mr. Rogers devoted his time to financing the enterprise, meeting with favor among business men of Worcester and surrounding towns; while Mr. Hunter confined his efforts to the actual work of laying plans for the proposed plant and the thousand and one details attending. Six months after the tests were made the proposition was taken before the directors of this board and endorsed.

By settling on the policy of making the corporation a purely local one the promoters got the co-operation they sought, with the result that with the exception of Mr. Hunter the entire directorate is made up of local men, as the following list will show: President, Marcus L. Foster, President of the Stone & Foster



EXTERIOR OF PLANT, LOOKING SOUTH, SHOWING SIDING AND LOADING PLATFORM.

Lumber Co.; vice-president and treasurer, F. Lincoln Powers, president of the F. E. Powers Co.; directors, Frank H. Hunter, Hartford, Conn.; Charles Firth, agent of the Boston & Albany Railroad Co.; Lyman F. Gordon, president of Wyman & Gordon Co.; Edward J. Cross, president of E. J. Cross & Co.; Robert L. Prentice, real estate; and A. B. Davidson, president of the Leicester Savings Bank.

As pay for their services and work in connection with the organization of the corporation and preparation for business the Connecticut Engineering & Construction Co. received the contract for the remodeling and equipping of the Tannery property, and a nominal number of shares of common stock, whose voting power is represented in the directorate by Mr. Hunter alone.

The sand-lime brick resembles Indiana sand-stone, and is claimed to be, to a certain extent, a reproduction of nature's own process. Its principal difference, however, is that it has no seams or laminations.

The Government's definition of the product, prepared by S. V. Peppel and published at the Government Printing Office, is contained in this summary:

"Sand-lime brick or sand brick, or the 'Kalksandstein' of the Germans, consists of sand particles which are bound together by a network of calcium silicate, or calcium-magnesium silicate, or calcium-hydro silicate that has been formed by the action of steam under pressure upon a mixture of sand or granular silicate and lime; this lime may be either a high calcium lime or a magnesium lime which has been hydrated prior to the time when the mixture is moulded into the desired form. The formation of this calcium-silicate bond is just as distinct a chemical reaction as fusion, and the result is the production of a mass in many ways similar to that produced in the dry-press brick when it is burned."

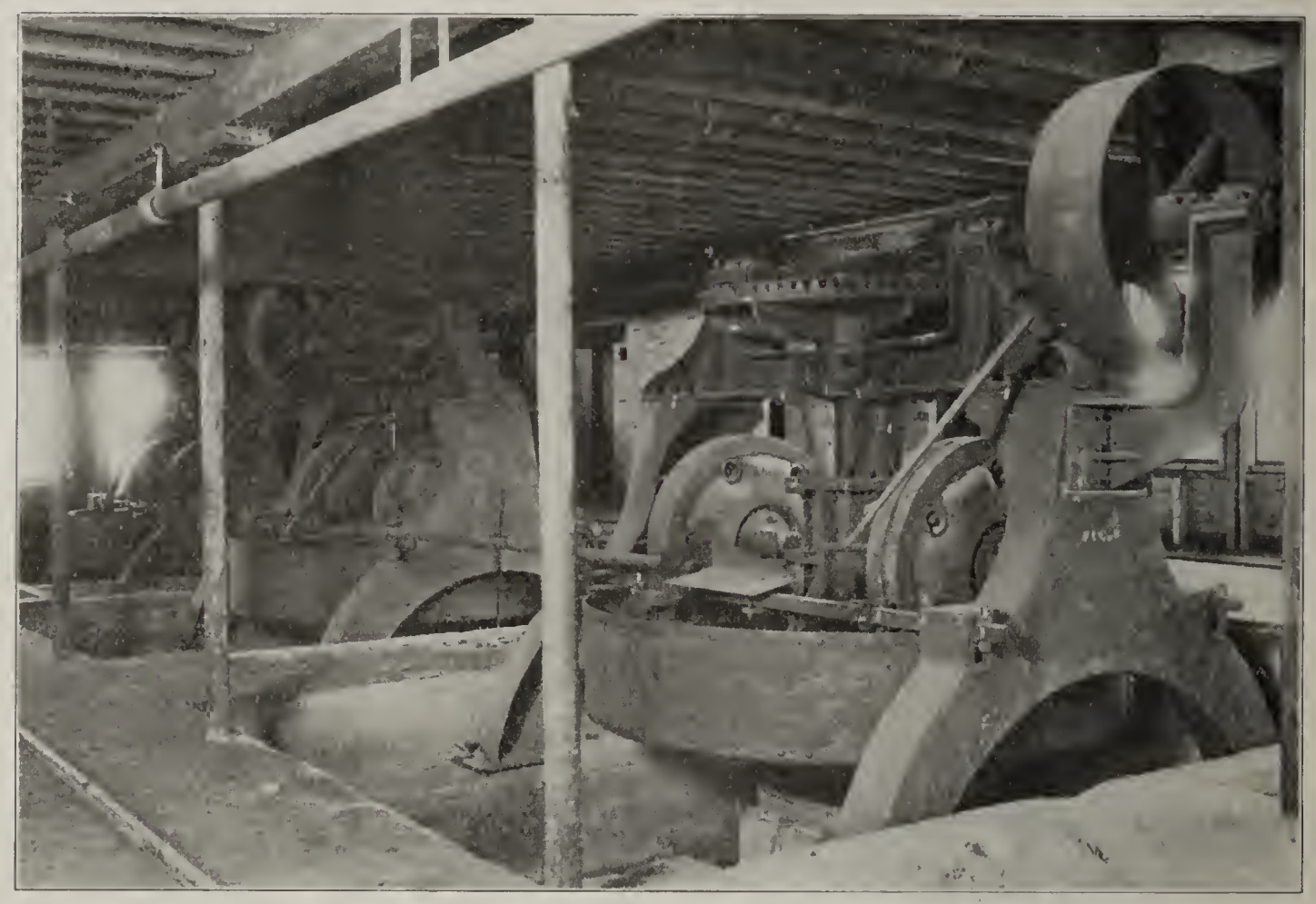
"Sand and lime hardened by the action of steam under pressure form a bond of calcium silicate which combines particle with particle by extracting enough silicate from each to satisfy the chemical affinities of the hydrated lime."

Producers of building material, like other commodities, have their arguments in favor of their own particular product over others, and the Worcester Sand-Lime Brick Company is no exception to the rule. To attempt to enumerate all of them would be a violation of the rules governing matter printed in the industrial section of the Worcester Magazine, but among the important claims made in favor of the sand-lime brick over the common clay brick are: its color, strength, fire resistent properties and the general uniformity in size and shape of each brick. The claim is made that the sand-lime brick will withstand a heat test of 3,000 degrees with the only apparent damage to the cube after 96 hours in a kiln being a slight discoloration, thereby making it an excellent fire brick. Equal claim is made, on the other hand, of its resistent-to-climatic changes. The ease with which the brick can be produced in any color desired by the addition of a harmless chemical is also considered another argument in its favor.

The plant of the Worcester company is considered among the best arranged and equipped in the East. It consists of a main factory building of frame construction, 35 feet by 95 feet, two stories high; a sand

screening and lime hydrating plant, 25 feet by 30 feet, three stories high, of frame and brick construction; a power house, 50 feet by 30 feet, of brick and frame construction; and a sand-lime brick stack, 85 feet high with a 42-inch flue.

a half-dozen similar plants erected by the company in as many years. Every department and every machine has been so located that the operation of the making of the brick is a continuous one without any unnecessary handling or moving of the product. From the

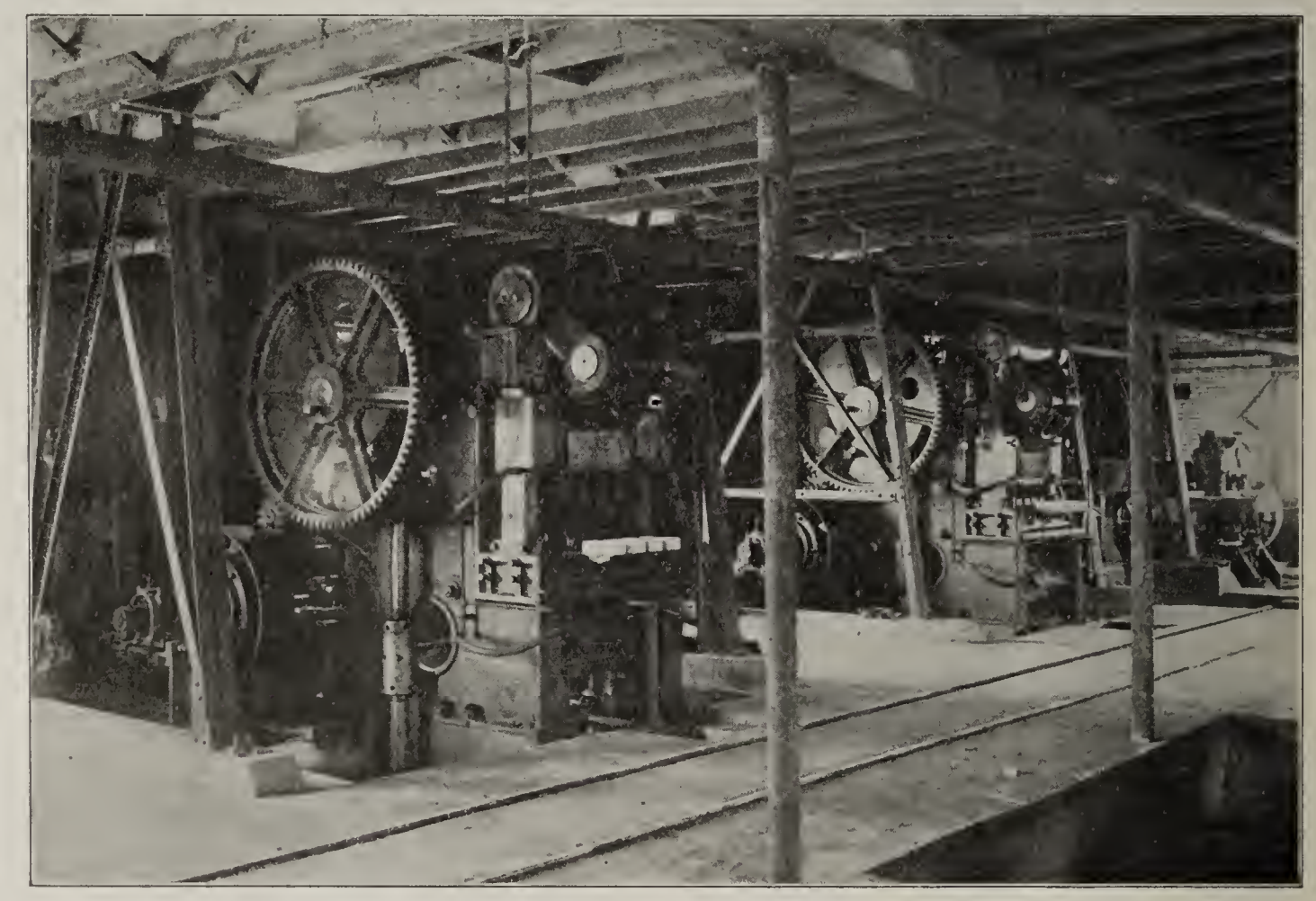


THE MASSIVE MIXING MACHINE.

A siding from the Webster branch of the Boston & Albany Railroad, 900 feet long, connects the factory with the railroad, drawing up to a newly constructed and substantial loading platform which extends nearly 200 feet on the northerly side of the building.

time the sand is screened, the lime hydrated and the mixture set to churning in the huge mixers the operation is continuous until the finished product appears.

Mining of the sand is to begin less than ten feet from the northerly side of the building, on a level with the ground floor of the plant. The cars will be run to the huge bank of sand from tracks which extend from the building. When filled they are returned to the build-



THE BRICK PRESSES, EACH WITH A CAPACITY OF 20,000 DAILY.

The arrangement of the various departments of the plant as worked out under the personal supervision of Mr. Hunter is said to contain the good features of

ing, transferred to an elevator and carried to the second floor, where the sand is screened and allowed to pour down into the huge mixing machines. The lime hydrating plant is close by on the second floor, on a level with the loading platform. When the lime is unloaded in barrels it is rolled into the plant directly over two absolutely fireproof lime silos of solid concrete, each with a capacity of a carload of lime. The two huge concrete vats enable the company to have a carload of lime completing hydration while the contents of the other is being used. The hydrated lime is removed to the silo on the ground floor, within five feet of the mixing machines. This particular building of the plant is entirely new, and was designed under Mr. Hunter's personal supervision.

All of the brick making machinery is located on this ground floor of the plant, resting on a foundation of concrete flooring from eighteen inches to six feet in thickness. All of the machinery is the latest of its kind which has been produced, and was obtained from the American Clay Machinery Co. of Bucyrus and Willoughby, Ohio, the largest manufacturers of brick machinery in the world.

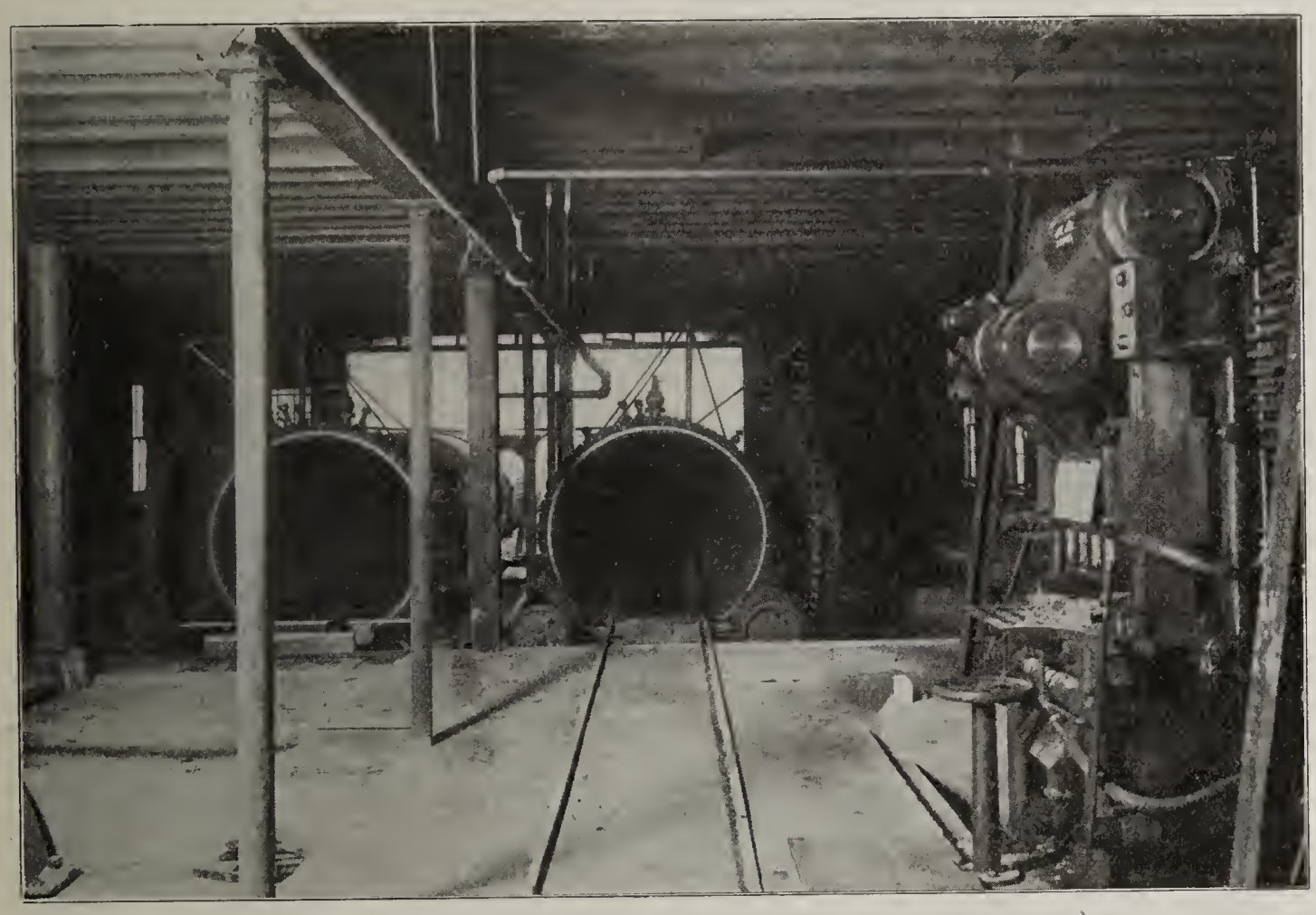
Lined up on one side are three huge mixing machines, massive structures which churn the sand and lime together much after the manner of kneading bread. Directly across an aisle, left vacant to permit the passage of hand cars on tracks, are located the brick pressing machines, two with a capacity of 20,000 bricks each in ten hours, and a third for high-grade facing brick, which has a capacity of 14,000 bricks in a similar period.

As fast as the mixture is completed it is transfered directly into the presses, and the bricks are turned out in a continuous stream to be loaded on the small cars standing on the tracks, an arm's length away. When the cars are filled they are propelled away on the tracks directly into massive hardening cylinders, where the final or "cooking" process takes place. Two of these cylinders have been installed, each with a capacity of 20,000 bricks. They are each 72 feet long and 6 feet in diameter, weighing thirty tons each. They are equipped with rails, so that the cars when rolled in can remain in the cylinders while the bricks are hardened. This so-called "cooking" process is caused by filling the cylinders with live steam after sealing the opening and allowing the process to continue for ten hours.

These cylinders are sealed at the close of work each night and at 4 o'clock the following morning the watchman blows off the steam, so that the cylinders can cool in time for the workmen to unload them when they arrive in the morning. This is simply done by pushing the cars out, and either taking them upstairs on the elevator and directly into waiting freight cars, or transferring them out of doors to be piled in the yard to await wagon or automobile shipment.

The power plant of the factory is thoroughly modern and of sufficient capacity to provide for future growth. The boiler room, made of sand-lime brick, is as near fireproof as is possible to make it, and as an additional precaution it is separated from the main factory building by a fire-wall of sufficient thickness to stand in any emergency. The equipment in the boiler room consists of two 150-horse power Stewart boilers. Apparently the company has faith in its product for fire brick purposes for both of the huge boilers are walled and lined with sand-lime brick. In this room is also located a water gauge which connects with a water reservoir on the roof of the building and which registers to a gallon the amount of water on hand. This reservoir is fed from the company's brook, which passes close to the boiler room, by means of a modern power pump.

Adjoining the boiler room is the engine room, cut off by another fire-wall, faced with the highest grade brick produced under the sand-lime process. This room is encased in hard pine, finished in the natural wood. One of the latest type Fitchburg engines of 175-horse power has been installed and tested. Here is also located the pumping plant of the factory, consisting of two Blake pumps, each of sufficient daily capacity to serve the wants of a sand-lime brick factory half again the size of the present one. It is intended to have one of these pumps in reserve at all times, so that if one breaks down the other will be ready for business at an instant's notice.



LOOKING INTO THE HUGE HARDENING CYLINDERS.

VALUE OF WASHED SAND AND GRAVEL IN CONCRETE.

To safeguard against the failure of structural concrete it is today considered most essential that the cement shall be tested and that it prove itself a good cement according to a well-defined set of requirements. A cement that fails to meet these requirements is summarily rejected. Likewise the proportions of crushed rock, gravel and sand are definitely specified, and fairly rigid rules are laid down as to how the aggregate shall be mixed—with a general object in view of seeing to it that the whole shall be fully filled.

But there have been many cases where, when a concrete aggregate fails to be properly in point of setting or developing the required strength, it is found that the failure is due not to poor cement nor to poor workmanship, but to the poor quality of the rock or sand employed. Engineers generally seek to get around this probable point of failure by specifying that there shall be used only "clean, sharp screened sand," and "clean screened coarse gravel, free from loam or other foreign matter."

VIEW OF MACHINE FOR LOADING GRAVEL INTO CARS AT THE BARNES SAND & GRAVEL PLANT, PORTSMOUTH, OHIO.

Yet specifications rarely go beyond this too general and too easily evaded requirement as to the quality of the sand and gravel. This is probably due to the fact that it is pretty difficult to determine the cleanness of the sand and gravel and its freedom from "loam or other foreign matter."

An interesting and highly instructive series of tests of concrete made from washed and unwashed sand has recently been completed by Smith, Emery & Co., Los Angeles and San Francisco. These tests prove conclusively that the ordinary sand and gravel used in concrete structures in Los Angeles will, after being washed, produce a concrete aggregate of so much greater strength that there is no room for comparison in point of quality.

These tests show that by using a mixture of 1:3:5 of the washed material, or a proportion of 1 part of cement to 8 parts sand and gravel, a greater crushing strength was developed in twenty-eight days than by using 1:2:3 mixture, or a proportion of 1 of cement to 5 of unwashed sand and gravel. This saving in the amount of cement more than offsets the added cost of washing the sand and gravel—in fact, it is estimated that while securing a greater crushing strength with nearly half the amount of cement, a saving of from 15 cents to 25 cents a cubic yard would be made.

The following are the reports of compression tests conducted in Smith, Emery & Co.'s laboratories, the prisms being 6x6x9 inches, area 36 sq. ft., the prisms being stored in moist air at 70 degrees F. All specimens were made from one sack. The unwashed sand and gravel was taken from a building under construction in Los Angeles.

Crushing Strength—Pounds Per Sq. In.

Mixture: L. A. City Specifications.

	7 days.	28 days.
1 part cement	602	1180
2 parts unwashed sand	639	1105
3 parts screened crushed rock	555	1302
Average	599	1195

Mixture:

1 part cement	602	1444
3 parts washed sand (14 mesh and finer)	555	1480
5 parts washed gravel (1½-in. to 1½-in. mesh)	539	1397
Average	565	1440

Mixture:

1 part cement	1076	1922
3 parts washed sand (8 mesh and finer)	1084	1916
5 parts washed gravel (8 mesh to 1½-in.)	1126	1913
Average	1093	1917

Tests of tensile strength, as between standard Ottawa sand and 14-40 mesh washed sand were made with briquettes 24 hours in moist air, the remaining time in water, temperature 70 degrees F., showing the following results:

Tensile Tests—Pounds Per Sq. In.

Standard Ottawa Sand		Washed Sand, 14-40 Mesh	
7 days	28 days	7 days	28 days
305	450	250	440
265	425	250	425
295	425	250	435
285	430	250	400
287	432	250	425

These tests are food for thought for discriminating architects, engineers and contractors. The fact that the tests show a great saving in cement with a gain, instead of a loss, in strength where washed sand and gravel are used, may be taken as conclusive proof that where stone or gravel is employed that is coated with dirt of any kind, the cement cannot reach the stone but is allowed to set up against this film of foreign matter, which serves only as a form for the cement. Where washed sand is used the cement coats the clean surface of the material during the dry mixing, and then when wet the cement fills every void and cavity, both in the gravel used and in the spaces between the sand and gravel.

A good illustration of this is cited in the history of a large contract for a concrete building erected in New Brunswick, as described by E. S. Larned, C. E. Boston, in a paper read before a recent convention of the National Association of Cement Users:

"It is gratifying to note the growing appreciation of the important part sand plays in all cement work; in very many instances poor results are directly chargeable to the sand used. No cement will improve properly if mixed with very fine sand and results will vary with the characteristics of the fine material. It must also be kept in mind that an intimate mixture of cement and fine sand is very difficult to attain, and a thorough distribution of cement throughout the sand voids is absolutely essential to good results. Sand that looks good is not always above suspicion; the following instance will serve to show the importance of testing the sand before use. An important hydraulic work was begun last spring at New Brunswick, and the contractors and engineers had congratulated themselves upon having what appeared to be an ideal deposit of sand and gravel for concrete work. The cement was thoroughly tested with standard sand, with good results. When everything was ready an active start was made and considerable concrete was placed before any doubts arose; it would not set up, however, in a week's time (or longer as it proved) and the cement was immediately tested again, with favorable results, and then some of the sand was examined. On the washing test it was noticed that a light opalescence was imparted to the water, remaining in suspension several days, but leaving practically no deposit or sedimentation. The cement was then tested with this sand before and after washing, and the trouble was at once located. The sand and gravel were both washed thereafter, and good results followed."

Many other instances might be cited where concrete structures have failed by the use of dust-covered sand and gravel. The very presence of foreign material in the concrete aggregate, aside from its probable effect on the binding together of the material, offers a chance for weakness that should not be overlooked.

The Wabash Portland Cement Co., Ford Bldg., Detroit, Mich., has closed down its plant at Stroh, Ind., for a few months for repairs.

SAND AND GRAVEL NEWS.

The new mill of the Union Sand and Material Co. at Arkansas City, Ark., which represents an investment of about $100,000 is now in operation. The mill will be operated indefinitely, the company having a contract to furnish the Iron Mountain road 1,000,000 cars of ballast. About 60 hands are employed at the plant.

In a letter received by the city commissioners yesterday afternoon from the Lavoy Sand and Gravel company, Edmonton, Alberta, Canada, that firm predicts a more serious shortage of gravel in the city next year than existed this year. The letter, which is as follows, has been referred to Commissioner Chalmers, to take what action he thinks advisable:

"As perhaps you are aware, we opened up a gravel pit at Lavoy, 75 miles east of here, about six weeks ago, and since then have been shipping our entire output to you at various points, chiefly the new car barns, to which we have shipped about 2,00 yards up to date.

"To enable us to give you all that you required we refused to accept orders from numerous other people, various contractors included, who were very anxious to procure a supply, when the scarcity of it was most felt, with the result that now the rush is easing off, it is useless for us to approach them for the purposes of sale, and as you also are ceasing operations we are left with the choice of either closing down or storing our supply until the spring once more.

"Under these circumstances we feel that it would be to our mutual advantage if it were possible for us to come to some arrangement with you whereby we continue shipment and store it wherever you would find it most convenient for use with the approach of spring, as we are firmly convinced that the scarcity of this commodity will be felt to a greater extent in the coming year owing to the abnormal expansion in this great western city.

"In the event of your giving this proposal your favorable consideration and finding a suitable site with trackage facilities, we can commence shipment immediately and can quote you a price of $2.85 a cubic yard.

"We are able to sell it at this reduction in price from what has lately prevailed owing to the fact that we can get cheaper labor from the farmers in the district who have finished harvesting operations, than is possible at any other time in the year, and expect a recurrence to higher prices next year than has prevailed in the past."

Is the sand monopoly in Kansas City part of a trust that extends to other cities? Builders in Kansas City are sure it is and that its tentacles now are reaching after absolute control of the crushed rock industry, says the Kansas City Star.

It is asserted that the Union Sand and Material Company of St. Louis and the Stewart-Peck Sand Company of Kansas City, the controlling companies in their respective cities, have merged, and are mapping out other fields to conquer. The general plan is to extend their control of river front sand facilities to all the river cities that have shipping facilities in Missouri and along the Kaw in Kansas.

Because of the high price and the poor quality of sand delivered builders have been resorting to the use of rock screenings as a mixture for cement, where it is permissible. So the trust is going to get control of that channel, too, according to reports from St. Louis and information which the builders claim to have from those connected with the sand industry in Kansas City.

Nor is it to stop there. The Kansas City Portland Cement Company is already reported to be under the same ownership as the sand trust and there is a possibility of a merger of the sand, crushed rock and cement monopolies in one big syndicate. Negotiations began two months ago when a representative of the St. Louis combine met with representatives of the sand and rock interests of this city in the office of A. P. Nichols. Now it is asserted the deal has about reached a consummation, notwithstanding the denials of those managing the controlling companies.

A combination of sand and gravel companies in Baltimore has been perfected under the name of the Arundel Sand and Gravel Company, with a capitalization of $2,600,000.

Frank A. Furst will head the new enterprise and Joseph J. Hock, now general manager of the Arundel Sand and Gravel Company, will be vice-president and general manager of the merged corporations. Of the capitalization, $1,000,000 will be in 7 per cent preferred stock, $1,000,000 common stock and $600,000 10-year 6 per cent, mortgage notes.

The companies in the combination are the Filbert Paving and Construction Company, the Sanford & Brooks Company, Potomac Sand and Gravel Company, the Arundel Sand and Gravel Company, the Furst Concrete Scow Construction Company and the Washington Stone Company.

The deal was put through by the Fidelity Trust Company, and that institution is now forming a syndicate to underwrite the new securities.

WILL ENLARGE LIME PLANT.

The Dutchess County Hydrate Co. Inc., has been incorporated under the laws of New York to take over the plant and property of the Dutchess County Lime Co., at Dover Plains, New York. The officers of the new corporation are Paul M. Pierson, Scarborough on the Hudson, N. Y., president; R. N. Soper, New York City, vice-president and general manager; H. C. Pierson, New York City, secretary and treasurer and W. C. Smith, Dover Plains, N. Y., superintendent. Mr. Soper the general manager with offices at 111 Broadway, New York, is well known in the lime business as he was formerly connected with both the Ash Grove and the Tidewater Portland Cement companies both of whom have large lime plants.

It is the intention of the new company to enlarge the old plant to three times its present capacity and to build a large hydrating plant. Richard K. Meade, chemical, mechanical and industrial engineer, 202 N. Calvert Street, Baltimore, Md., has been engaged to prepare plans and specifications for the new plant, which will be modern in every way and will take advantage of all recent improvements for securing a high quality product at a minimum cost. The kilns will be especially designed by Mr. Meade and the hydrating plant will be motor driven and strictly up-to-date in every way. A large store house equipped with conveyors will also be built.

The Dutchess County Lime has been on the market for a number of years and is well known in and around New York City for its excellent qualities and is a favorite lime for finishing. The limestone deposits owned by the company at Dover Plains are very extensive and the stone is high in magnesia and very pure.

THE COAL INDUSTRY IN KANSAS.

Coal stripping operations are greatly stimulated by the advance in price of coal and active demand. The following prices are quoted F. O. B. cars at the mines in this district for November shipment:

Shaker Screened Lump	$2.75 per ton
Shaker Screened Nut	2.50 per ton
Shaker Screened Slack	1.50 per ton
Mine Run	2.25 per ton

The coal stripping steam shovels are all working and four new ones are being erected. By the end of next month there will be 20 of them in active operation in the Pittsburg, Kansas, district. All of them have been put in operation within the past two years, which demonstrates conclusively the greater advantage and economy in strip mining as compared to underground shaft mining. The coal in this field averages 3 feet in thickness or 4,000 tons to the acre and from 10 feet to 30 feet in depth of over-burden can be stripped with the new type of revolving steam shovels, at a low cost per ton of coal mined.

There are many thousand acres of good coal land available for stripping from 10 feet to 25 feet in depth of overburden which can be bought or leased and operated at a good profit, in fact the Kansas coal fields offer greater inducements for coal mining than any other section of the country. The coal is of a good quality, being quite free from sulphur and burns freely with but little clinker, says the Kansas City Times.

The increased demand for soft coal is largely owing to the withdrawal of crude oil from the market also the failure of the natural gas supply both of which have been extensively used by the middle west and southwest railroads and manufacturers. We know of one Portland Cement plant alone, formerly operated with natural gas, which is now using from 400 to 500 tons of soft coal per day and there are many others. In Missouri, Kansas and Oklahoma there are a large number of brick manufacturing plants, some of them very large, making vitrified paving brick and building brick in great varieties which have been using natural gas or crude oil for fuel, now they must use coal, which amounts to millions of tons yearly all of which is evidence that the coal business is flourishing with good prospects for the future.

THE BRADLEY THREE-ROLL MILL.

For Grinding Limestone for Agricultural Purposes.

We are in receipt of a copy of the new Bradley Three-Roll Mill Catalog No. 42, which has just been received from the printer. The Bradley three-roll mill is manufactured by the Bradley Pulverizer Company of Boston and is especially adapted to the grinding of limestone for agricultural purposes and is working exceptionally successful in grinding of this material. It is a large capacity pulverizer which gives a finished product of exceptional firmness and is low in cost of up-keep. The Adams & Duford Company, lime manufacturers, Chaumont, N. Y., just purchased one of these machines for pulverizing limestone for agricultural purposes.

The Bradley Pulverizer Company, Boston, Mass., also announce that they have just received an order from the National Cement Company of Caracas, Venezuela, for a Giant Griffin mill installation.

The Physical and Chemical Properties of Portland Cement

A paper on "The Physical and Chemical Properties of Portland Cement," by W. C. Reiblin and F. D. Reyes, Bureau of Science, Manila, P. I., read at the Eighth International Congress for Applied Chemistry, gives an account of a very extended investigation. The main effort in this work was directed toward a study of those characteristics of Portland cement regarding which there exists the greatest amount of misconception and diversity of opinion, the object being to assist in the universal effort to formulate cement specifications so drawn as to guarantee the manufacture and use of Portland cement of the quality sought for.

A brief summary of all the important conclusions arrived at cannot be made, the interdependent nature of such conclusions preventing a brief statement of facts. However assuming that the quality in Portland cement which we need is constancy in volume and setting properties, and reliability in strength, and that it is of vital importance that this material both hardens rapidly and maintains a great strength, we believe that the enforcement of the following recommendations will increase the efficiency of the present standard cement specifications of the American Society for Testing Materials.

"A. Concerning the constancy of volume: (a) We can not hope to secure the desired efficiency in Portland cement unless the maunfacturer is induced to burn his materials so that no seasoning is required to produce a sound cement. Therefore, it is necessary to demand perfect soundness in conjunction with a high specific gravity, and we recommend: (b) That failure to meet the requirements of the accelerated tests shall (in place of 'need not' as now specified) be sufficient cause for rejection.

"B. Concerning the specific gravity: (a) That the best burning and proper storing produces a product which has a high specific gravity (or low loss by ignition). Therefore, (b) That the specific gravity of the cement as received (i. e., dried but not ignited) shall not be less than 3.10 unless the loss by ignition is less than 2.00 per cent. (c) That the above recommendation provides for the possibility of a well-burned cement with a lower specific gravity provided the low gravity is not due to subsequent absorption of volatile constituents; but our experience does not include such a possibility. (d) That the clause 'Should the test of cement as received fall below this requirement a second test may be made upon a sample ignited at a low red heat' be omitted. (e) That the clause 'A low specific gravity in conjunction with a high loss by ignition is positive proof of undesirable burning, adulteration or seasoning' be substituted for the present paragraphs concerning the significance of the specific gravity.

"C. Concerning the fineness: (a) As the specifications now stand, there is little incentive to induce the manufacturer to grind to the degree of pulverization that modern improvements in grinding machinery has made practicable unless his cement is so poor that extreme fineness is necessary to enable it to pass the requirements for strength and soundness. Therefore, (b) That the cement shall leave a residue of not more than 5.00 per cent by weight on the No. 100, and not more than 20 per cent on the No. 200 sieve.

"D. Concerning the tensile strength: (a) That the average of at least four briquettes representing at least two separate mixtures of the same sample shall be taken for each test, excluding any results which are manifestly faulty.

"E. Concerning retests: (a) Manufacturers should be impressed with the fact that these are minimum requirements; that ample provision already has been made in the specifications for lack of uniformity in testing as well as in real quality; and that we demand a quality so superior that, regardless of the variable factors, the ability of the cement to pass all requirements shall be a certainty. Therefore, (b) That the results obtained from the original test shall be considered as final unless it becomes evident that a serious error in sampling or testing has resulted in totally misrepresenting the quality of the cement. In other words, that 'border-line' cements should be avoided as much as possible.

"F. Concerning the practical significance of the above recommendations: (a) Manufacturing conditions are such that we cannot hope to secure Portland cement which contains no free lime. Also, it is realized that the proposed specifications are not perfect. However, we believe that the enforcement of the above recommendations will support and promote the best practice in grinding and burning, and accordingly, secure greater uniformity and efficiency than the present specifications. (b) Without the hearty, honest cooperation of both manufacturer and user little can be accomplished. The degree of fineness and burning are important financial considerations to the manufacturer, and the consumer should buy on a basis of quality. (c) The testing of a great number of commercial Portland cements from many parts of the world has convinced us of the feasibility of these recommendations from both an economic and practical standpoint, and the results obtained have repudiated all claims to the contrary. For instance, a certain manufacturer in America stated that owing to a long sea voyage he could not guarantee his cement to pass the 3.10 requirement for specific gravity. Our work showed conclusively that cement stored in good barrels undergoes very little change due to atmospheric influences and many cements imported from Europe and America show consistently a gravity above 3.10 and a low loss by ignition. There are cements, which, as stated in the 'Introduction' of our work, show the most remarkable uniformity in physical properties.

"We desire to emphasize the importance of the calcium hydroxide-phenol microscopic test for free lime, as in every instance the physical and chemical properties of the different products examined demonstrated the accuracy and usefulness of this test. As stated, we believe that in the hands of an expert it gives more definite and reliable information regarding the constancy of strength and volume than the usual 28-day or even 3 or 6-month test. However, there is one undesirable feature to this test; namely, that it requires considerable experience and ability correctly to interpret the significance of the phenolate crystals formed on the microscopic slide. Therefore, in order to make this test generally practicable and universally dependable it must be simplified or made quantitative. Certainly, its possibilities and importance warrant much more extended research in this direction than we have had opportunity to accomplish."

The Santa Cruz Portland Cement Company's Plant Davenport, California

By Llewellyn F. Bachman, Chemist

The Santa Cruz Portland Cement Company's plant is located at Davenport, Cal., ten miles northwest of Santa Cruz, directly on the coast. It is reached by the Southern Pacific and Ocean Shore railroads from Santa Cruz. Deep water shipping facilities are obtainable at a distance of about 1000 feet from shore.

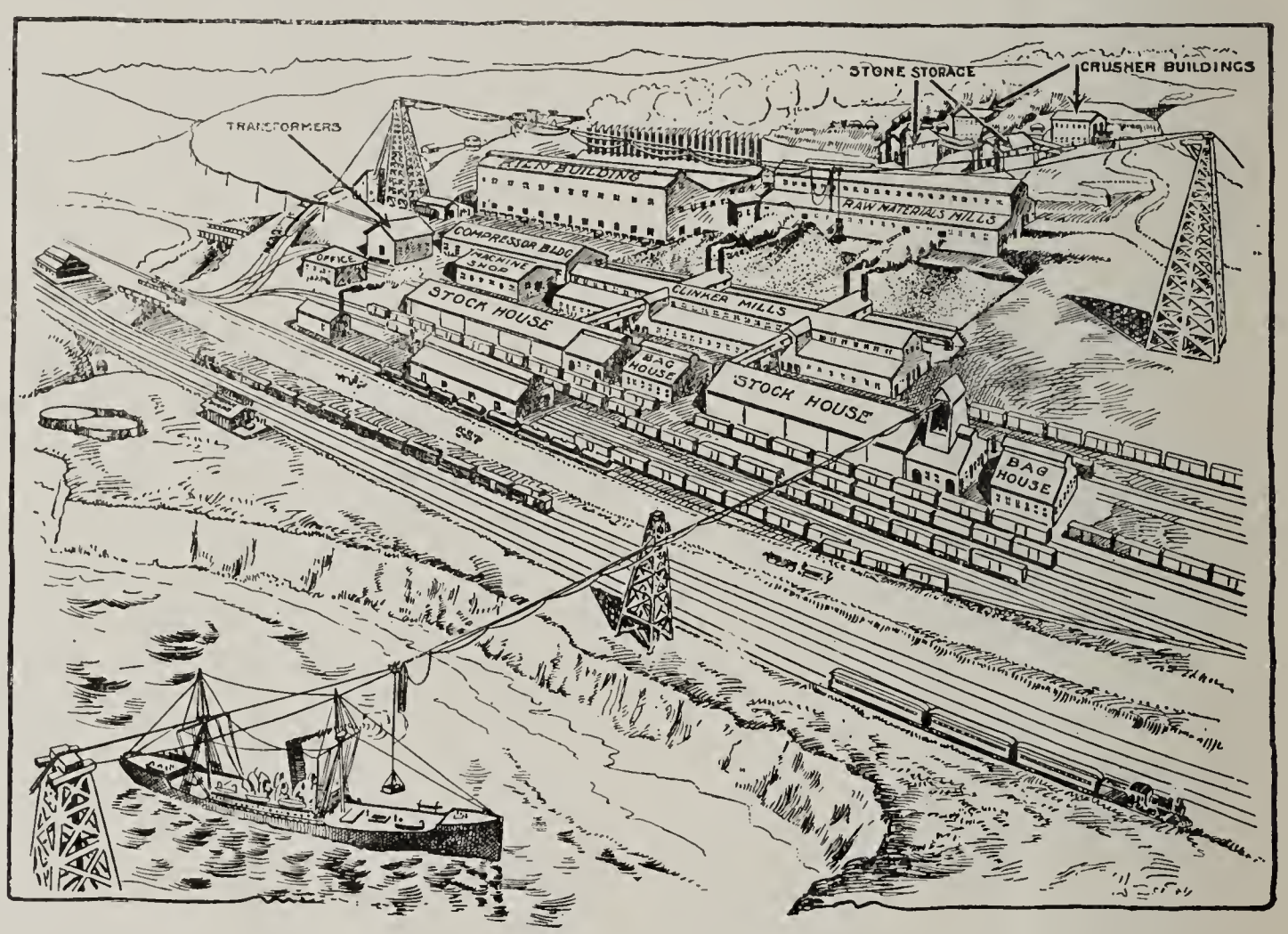
The plant area covers about sixty acres, and has been in operation since April, 1907. The company's holdings, on which are located deposits of limestone, clays and shale, constitute over 2,000 acres. All buildings are constructed of concrete and steel.

The limestone is quarried from enormous deposits in the San Vicente canyon, at a distance of two and eight-tenths miles from the plant. The floor of the quarry was formed by blasting down the limestone on both sides and filling up the canyon to a depth of eighty-five feet. The precipitous cliffs rise on both sides from 300 to 500 feet from the quarry floor level. The quarry floor now covers an area of about 1000 feet in length and 150 feet in width, and is maintained in two working levels.

At the entrance to the quarry a heavy structure eighty feet in height is thrown across the canyon, which forms the bins for the crushed limestone. In this structure a large No. 9 Gates gyratory crusher, operated by a 150-horse-power motor, is mounted on a massive concrete foundation at an elevation of seventy feet, which discharges its crushed product into these bins. The rock from the quarry is delivered to the crusher by means of Flory & Lidgerwood hoisting and cable apparatus and by three-ton cars on narrow-gauge tracks. The daily output from the quarry varies from 1,800 to 2,200 tons of limestone.

The clay, which is of a high aluminous character is obtained from the company's deposit at Tank Siding, sixteen miles north of Santa Cruz. About 190 tons are consumed per day.

This deposit of diatomaceous shale is located directly back of the crusher building. Owing to its high silicious character, this shale cannot be practically used for cement without an addition of an aluminous clay. When the clays which constitute the light overburden and narrow seams in the limestone quarry are of higher or lower silicious content, the clay and shale is varied in proportionate amounts to preserve constant silica-alumina ratio in the raw composition. It is found that a three component mix is therefore a very flexible and favorable method for formulating a constant mixture.



The limestone is transported from the quarry to the plant in trainloads of eight cars of twenty tons each, over a standard-gauge track constructed along the west side of the canyon. The equipment consists of steel side dump cars of twenty-ton capacity, and two forty-ton Porter locomotives.

The cars containing the limestone are run over track scales to check the gross tonnage, from which the cars are dumped and the limestone discharged into

two No. 6 Gates gyratory crushers operated by one 150-horse-power motor. This constitutes the second reduction.

The two crushers are so arranged to discharge their product on to one twenty-four inch 15 degree inclined belt, 200-feet centers, which conveys the product into a rock storage capable of holding 16,000 tons. Three belts with three Robins automatic trippers serve to distribute the crushed limestone over the rock-storage area. By means of a system of tunnels and belting, the limestone is drawn out from underneath the rock storage on to a cross belt into two six by sixty-foot dryers. From the discharge end of the dryers, the limestone is elevated into a bucket conveyor, which delivers the material into the ball mill bins. All the bins are of a steel, hopper type of construction. At the same time the clay and shale is dried through similar-dryers, and their discharge delivered into the Ball mill bins.

A third reduction is accomplished through eleven Gates No. 8 ball mills for limestone, clay and shale, each of which is ground separately and their product elevated and conveyed into separate bins; six for limestone, and three, each of a different capacity, for clay and shale. Automatic samplers are arranged for sampling each of the three raw materials while their respective bins are filling. When these samples are analyzed and a raw composition formulated in the laboratory, the three separate materials are drawn out simultaneously into a battery of three automatic weighing machines, which again simultaneously discharge into a huge double-screw-cut flight mixer. From the mixer the raw composition is elevated and conveyed into the tube mill bins.

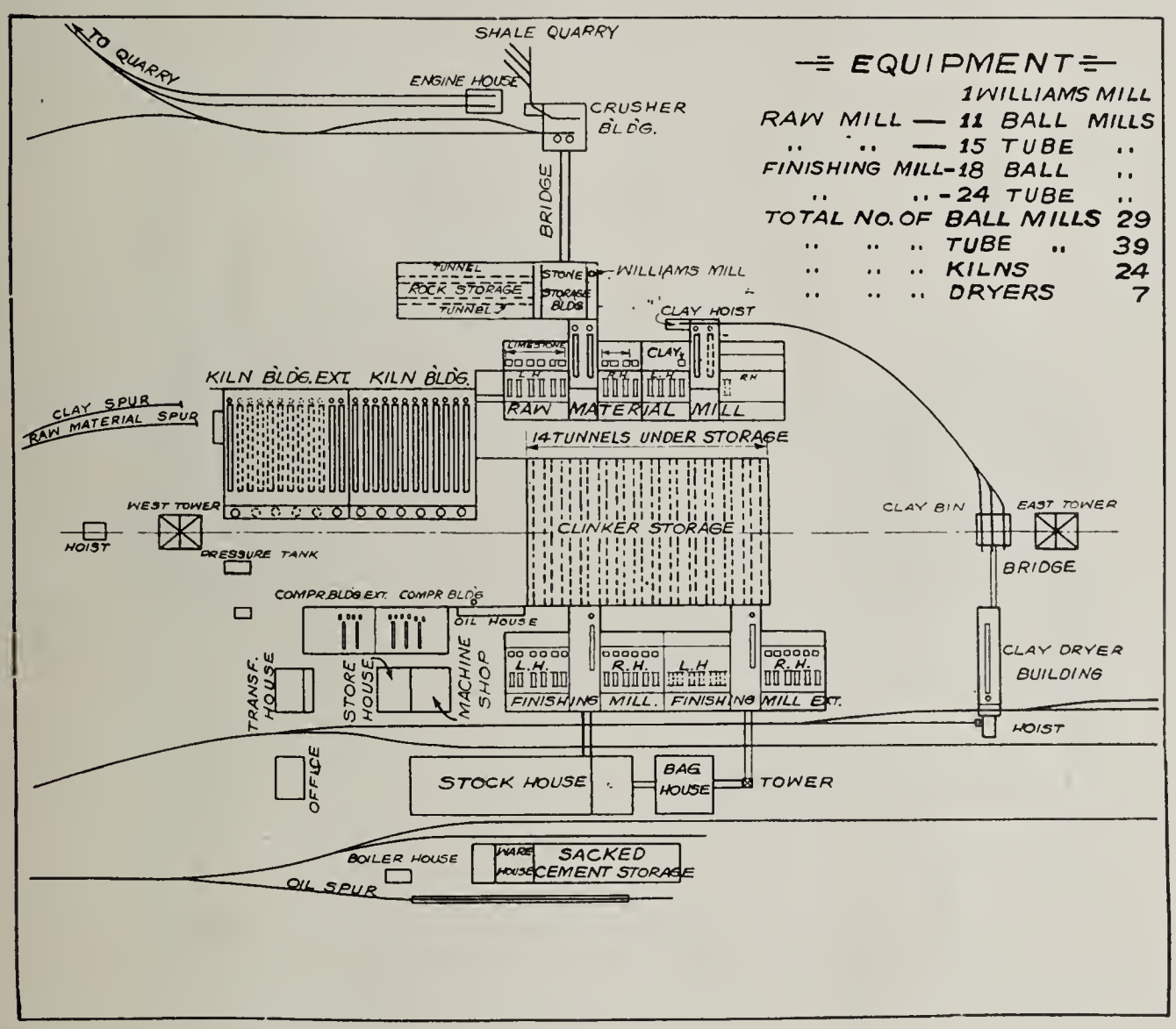
The tube mills giving the final grinding to the raw composition are of the Gates five and one-half-foot by twenty-two-foot type and are fourteen in number, operated in pairs by a 250-horse-power Westinghouse motor. The tube mill product, 73 per cent of which passes a 200-mesh screen, is discharged into one long continuous screw conveyor, where the raw composition is again automatically sampled and checked from the laboratory. The raw composition is then elevated and conveyed to the kiln bins.

By a large margin, this is the largest building in the plant, and is recognized as the largest kiln building in the world under one roof. It covers a floor area of 60,896 square feet, and houses twenty-four seven and one-half-foot by seven-foot by 125-foot kilns, which lie on an incline of a three-fourths of an inch pitch, and are individually operated by a thirty-horse-power variable speed motor with a controller at the burner end of the kilns. Each kiln is provided with a stack, five feet by eighty feet, at the far end of the kiln. Fourteen of the kilns are now in daily operation, each of which easily produces its 500 barrels of clinkers in twenty-four hours.

The raw composition is fed into the stack end of the kiln by means of screw conveyors from the hopper base of the kiln bins, which, under the rotation of the kiln, is carried onward and downward through the heat zone, where it is calcined to incipient fusion and discharges into a pit as clinker. The burning is accomplished with crude oil and compressed air. The oil is of 17 degrees Beaume gravity and the air pressure is eighty pounds at the burner. Approximately 2,000 barrels of oil are consumed per day.

From the clinker pit the clinker is delivered into coolers, which finally discharge into a portable steel skip on a narrow-gauge track, to be taken to an open-air clinker storage.

The clinker now in the steel skips, which hold thirty barrels, is delivered to the clinker storage pile by means of a Flory hoisting and cable apparatus. The two and one-half-inch steel strand cable, resting on towers at either end, 160 feet in height and 1,200 feet centers, supports a carriage, holding the suspended clinker skip which is run back and forth to the clinker



Sketch of Lay-out and Equipment of the Davenport Plant

storage. The dumping and operation is controlled from the hoist installation at one end of the cable. In the writer's opinion, one of the chief assets to a cement plant lies in a large clinker storage. It not only gives the plant flexibility, but gives an aging to the clinker which favorably affects its quality as well as the final grinding. The clinker storage at this plant covers an area of 80,000 square feet, on which approximately 500,000 barrels of clinker can be stored.

The clinker storage has fourteen tunnels underneath, into which the clinker is drawn through chutes directly on to belts which convey the clinker to a cross belt running into the finishing mill.

The clinker is received in a steel bin directly over the stack end of the dryer, provided with an adjustable rocker feed, which delivers the clinker into the dryer. While the clinker passes through the dryer a low heat is applied, when necessary, to drive off any water absorbed by the clinker through rains or damp atmosphere, thereby avoiding any clogging of the ball mill screens. To retard the setting time of the cement, about 2½ per cent of gypsum is added in the dryer discharge pit from a bin controlled by an adjustable rocker feed.

The gypsum is fed into the pit by a continuous belt, which delivers a continuous stream simultaneously with the clinker stream discharged from the dryer. This assures a thorough distribution of the gypsum and a well-regulated setting time of the cement.

From the dryer discharge pit the stream of combined clinker and gypsum is elevated and conveyed into the ball mill bins. Through the hopper of the bins the material is fed into the ball mills, eighteen in number, similar in type and size to those in the raw mill building. From the ball mill discharge the stream passes through elevators and conveyors into the tube mill bins. From these bins the material passes on into the tube mills for its final grinding. The tube mill installation consists of twenty-four mills, twenty of which are in constant operation. The tube mill product, which is the cement, is an impalpable powder, 80 per cent of which passes a 200-mesh screen. The product is elevated and automatically sampled while conveyed into a large stockhouse.

The stockhouse, which consists of ten separate bins, is of concrete construction throughout, and has a capacity of 128,000 barrels of cement. The base is of the hopper and tunnel-type construction, two of which run longitudinally through the entire length of the stockhouse. By means of screw conveyors, the cement is conveyed through these tunnels into the packing bins, adjacent to the stockhouse. Eight Howe packing machines mechanically fill the sacks, which are carefully weighed and tied and passed on trucks into cars.

Beginning at a point at one end of the loading platforms on each side of the stockhouse, two car tracks on a slight incline are run on an extended line of about 900 feet, to provide for car storage while loading. The incline enables the operator to shift his cars by gravity directly to the loading platforms, which provides for eight cars on either side. This arrangement has operated very satisfactorily on shipments of 10,000 barrels per day.

Another storage of 25,000 barrels capacity, adjacent to the stockhouse, is provided for storing cement sacked. The consumer who wishes to sample and test his cement before shipping is thereby given excellent facilities for storing and sealing his lot while waiting his twenty-eight-day test. A portable sack stacker, electrically operated, stacks the sacks in tiers of twenty-four sacks in height.

This building provides for both new and cleaned sacks. The sacks to be cleaned are placed in two cylinder drums in batches, the drums rotated and the bags thoroughly shaken. The slatted perimeter allows the cleanings to drop through the floor. The bags are removed from the cleaner through a door provided in one section of the slats. These two machines are wholly inclosed in a timber casing with a door for access, thus avoiding the dusty operation.

The air consumed at the limestone quarry for drilling apparatus, and at all the oil burners throughout the plant, is supplied by five Ingersoll-Sargent air compressors, four of which are of a duplex type 24¼ inches by 24 inches, and one a compound 25¼ inches by 16¼ inches by 16 inches; all of which compress to eighty pounds of pressure. The air consumed in cooling the clinker is supplied by six Sturtevant steel pressure blowers. The entire equipment is housed in this building and operated by two 800-horse-power motors.

The machine shop is fully equipped with various kinds of machines to facilitate all necessary repair work accruing in the plant. The adjoining storeroom has a full stock of supplies and duplicate machine parts, which are systematically segregated for convenient access, and its contents accounted for through a stock ledger. All withdrawals are carefully charged to the various departments in which the supplies are used.

Electric power, which is furnished by the Pacific Gas and Electric Company, is used exclusively in this plant. A description of its installation and equipment will be found in a different number. The current is transmitted to a total of seventy-eight motors, varying from one-half to 800 horse-power. The entire plant consumes approximately 6,500 horse-power when running under normal conditions.

The oil cars as received at the plant are run in trains, of eight cars over a concrete trench, into which the cars simultaneously discharge their oil. The trench has a sloping bottom from both ends to the center, where a twelve-inch pipe conveys the oil by gravity to two large storage tanks with a capacity of 37,000 barrels each, located at a distance of 600 feet from the oil trench, directly on the shore line of the ocean.

A pumping system delivers the oil from the tanks through pipe lines, supplemented by a steam pipe line to facilitate the flow of the oil, into a pressure tank from which the oil is distributed throughout the plant.

This department comprises the chemical and physical laboratories and the sample grinding-room.

The grinding-room has a complete installation of sample grinding machines and oil-testing apparatus.

The laboratories are thoroughly equipped with all the necessary apparatus for chemical and physical determinations on all materials pertaining to cement and cement manufacture. All methods conform with those prescribed by the American Society for Testing Materials.

This department accomplishes its work in six separate rooms, one each for the superintendent, chemist, timekeeper, shipping clerk, bookkeepers and draughtsmen, together with storeroom for office supplies, and concrete vaults for the preservation of records and drawings.

The plant is in operation both day and night throughout the entire year and employs a daily average of 550 men.

The Pacific Coast Concrete Co., recently incorporated for the manufacture of concrete brick, blocks and other concrete products, has opened a downtown office at 301 Exchange Bldg., Los Angeles, Cal. J. H. Gildner is president and manager. The company's plant is located at Fiftieth and Santa Fe avenue.

STEAM SHOVEL AND DIPPER DREDGE REPAIR PARTS.

Bulletin No. 55 of the Edgar Allen American Manganese Steel Co., McCormick bldg., Chicago, describes and illustrates the repair parts required for steam shovels and dredges.

Their "Stag" brand of manganese steel is well-known for its extreme toughness and durability. Conclusive proof of its superiority is shown by the fact that in the digging of the greatest excavation in the world, namely the Panama Canal, hundreds of tons of it were used on the steam shovels and dredges; also by the fact that the great mining companies on the Iron Range are enthusiastic over the economies which are being realized through its use.

The publication is now ready for distribution.

TRADE NOTES.

The Universal Concrete Pile Co., Jamestown, N. D., recently organized with a capital stock of $100,000, has been awarded a large contract by the Seaboard Air Line for forty-seven miles of work between New Jersey and Florida, which will take two years to complete.

The company builds the pile in place by a patented device and operation.

J. W. Stewart, proprietor of the La Porte City Cement Products Co., La Porte, City, Iowa, will build a one-story brick factory, 40x40, with a steam curing room, 18x20 feet.

LOCOMOTIVE CRANE HOISTING AND DEPOSITING CONCRETE RAPIDLY AND AT LOW COST.

It is being used by The Ohio River Contract Company, Evansville, Ind., on their work on Ohio River Dam No. 7. They have two locomotive cranes employed on this job and when notusing them for depositing the concrete they are employed for excavating soil and handling sand and gravel and driving and pulling piling and sheeting.

FOR SALE.

The Potter Lumber Company, Argola, Ill., have for sale a complete concrete block making outfit, consisting of one single and one triple block machine, brick, column, pier, base, baluster, sill, rail and other moulds. They have a splendid trade already established. This is a good opening for some one to locate quickly. Full particulars and complete list will be furnished on request.

THE UNIVERSAL CRUSHER.

The Universal Crusher Company of Cedar Rapids, Ia., has taken over the business of the Eureka Stone & Ore Crusher Company, of the same city. Hereafter both the Velten Universal crusher, heretofore manufactured by the former company, and the lines handled by the latter company will be manufactured at the Eureka plant.

PEORIA WASHED SAND AND GRAVEL COMPANY ARE BUILDING A NEW PLANT ON EAST SIDE OF RIVER.

The largest and most completely equipped gravel crushing and washing plant along the Illinois river is to be installed by the Peoria Washed Sand and Gravel company on the east side of the river, just north of the bridge. Pile driving has been started and a dredge will be put to work today or tomorrow.

A part of the equipment is composed of five large bins of five hundred tons capacity. A levee five hundred feet in length will be built along the bank of the river from the east abutment of the bridge north. Then from the north end of this levee another will be built back from the river four hundred feet, forming a harbor for the barges and boats in loading and unloading.

The railroad switch tracks will be laid out along the four hundred foot levee and large cranes will be used in handling the gravel from the bins to either railroad cars or barges. The company expects to have the plant in operation by the opening of navigation in the spring. They will ship by rail, wagon and water.

Electrical equipment will be put in for the driving power of the plant. The machinery consists of a crushing plant for the coarse gravel, an elevator and a series of screens for washing and grading the product. The gravel in the first place will be taken from the river with a clam shell outfit. From the barges it will be unloaded by the cable system. An investment of $20,000 will be required before the plant is ready for operation, say the managers of the company.

NEW QUARRY COMPANY.

Mr. S. B. Martin of Sault Ste Marie, Mich., has recently sold his Fiborn Quarry property and equipment to the Fiborn Limestone Company of Sault Ste. Marie, Ontario, and has organized a new company which is styled the "Martin International Trap Rock Company, Limited," under the laws of Ontario, with American office in the Adams building, Sault Ste. Marie, Mich. The quarries of the new concern are located at Bruce Mines, Ontario, where they have seven hundred acres of the very best of trap rock. One of the most modern and largest crushing plants in North America is to be erected at said quarry. The crushing machinery has been purchased of the Power and Mining Machinery Company of Milwaukee, and will consist of a

60x74" jaw crusher,
two No. 9 gyratory crushers,
two sets of 24 x48" rolls, and necessary screens and conveyors to screen the stone in six different sizes and deliver it into stock piles of seventy-five thousand tons capacity, and load from the stock piles into boats at the rates of twenty-five hundred tons per hour. Capacity of plant will be from five to six thousand tons daily.

The steam plant will consist of two Vertical Water Tube Boilers equipped with Jones Underfeed Stokers and Foster Super-heaters, Boilers and one Cross Compound Lentz Patent Engine of one thousand horse power, equipped with Blake Condensers, built by the Erie City Iron Work, Erie, Pa., and Worden-Allen of Milwaukee, Wis., have contract to furnish the structural steel work. Kilbourne and Jacobs of Columbus, Ohio, have contract to furnish forty-eight yard automatic lock quarry dump cars.

There are now at work in the quarry two Number 4 Clipper drilling machines, made by the Loomis Machine Company of Tiffin, Ohio, especially built for this particular quarry. Two 110 C Bucyrus steam shovels, one of which has been shipped and the second will follow during the summer of 1913. There is also on the ground at present at work one Brown Hoist Revolving Crane and one Industrial Revolving Crane, both used in construction of the plant. The Vulcan Locomotive Works of Wilkes-Barre, Pa., are supplying two forty-five ton saddle tank locomotives for hauling stone from steam shovel to crushing plant.

$400,000.00 will be spent in equipment of the plant. Mr. Martin has contract to start shipping stone by April 20th, at which time said plant will be in operation. The entire equipment will be turned over to the "Martin International Trap Rock Company," a corporation organized by S. B. Martin.

Ira M. Rose, a Tonawanda, N. Y. ship-owner, filed a libel against the Palmyra Sand Company of Buffalo in United States court yesterday.

He is seeking to recover $10,000 damages for an alleged breach of contract and $1,010 for demurrage. The contract covered shipments of sand and gravel from Palmyra to other points.

Wichita, Kansas sand dealers regard with no degree of sympathy an agitation in Topeka to tax the companies which take sand out of the rivers in the state. G. T. Walker of the Jackson-Walker Coal and Material company, offers that he regards as a most convincing reason why the state should not try to make the sand pumpers give over a share of their profits. He says there aren't enough profits to divide.

It has been proposed to introduce a bill before the next legislature calling for a tax to be levied upon the sand companies, which are regarded as getting millions of dollars out of what is supposed to belong to the state, namely, the rivers, without paying a cent for the privilege. Should such a law be passed it will be a tax on the people for they will have to pay more for sand, the dealers say.

"There is no justice in such a measure," said Mr. Walker yesterday. "Of course, the law may be passed. I have heard of foolish laws being passed before. But as a matter of fact, the sand companies are not getting rich from the rivers. We sell sand at only twenty cents a ton, and whatever certain legislators may say, it costs money to pump it. Moreover, we are not only not doing the state any harm by taking sand from the rivers, but we are actually doing what the government pays thousands of dollars every year to have done in certain streams. Sand pumpers dredge the rivers.

"There is no more justice in an attempt to make us pay for the sand we use out of the streams than there would be in an attempt to make the water companies pay for the water they pump out of rivers and supply to consumers.

"There is such a law, I understand, in Oklahoma, or, at least, one similar, and it has caused much dissatisfaction. The state has forbidden all sand companies to pump from the streams except one company with whom they have made a special contract. The state claims, of course, that it owns the rivers and can do what it wants to with them, but it looks to me as though the whole thing is graft.

TRAP ROCK.

The value of the output of trap rock in the United States in 1911 was $6,399,622, a decrease of $52,519 as compared with 1910. California and Massachusetts, according to the United States geological survey, were the two states showing increases in value of production. Crushed stone for concrete increased in value.

REDUCED FREIGHT RATES.

The Wisconsin railroad commission cut the rates on crushed stone, sand and gravel on the Chicago, Milwaukee & St. Paul road from 20 to 30 per cent. Recently the commission rendered a decision in the case of the Waukesha Lime & Stone Company recommending reduced rates. In the commission's decision on the rehearing of the case, it was recommended the rates therein ordered for Waukesha be made general throughout the state by the carriers involved. This recommendation was followed by the Chicago & Northwestern; and the Minneapolis, St. Paul & Sault Ste. Marie also, though not a party to the case, put into effect the commission's rates on these commodities. The St. Paul road, however, did not adopt the distance rates proposed by the commission, and various shippers on that line of railway complained informally to the commission.

Because of this neglect, the commission, upon its motion, gave notice of a hearing to the St. Paul road, which followed by today's decision by the commission. It is estimated the decision will mean a saving of thousands of dollars annually to shippers of sand, gravel and stone.

Officers of the Monroe Stone Company, Lansing, Mich., came before the state railroad commission last week and asked that it require the Lake Shore & Michigan Southern railroad to reduce its shipping charges $3 a car and to return $3 a car, which it charged in excess of the former rate, for several months.

The former rate of $2 a car was raised last summer to $5. The charge is for hauling cars of stone out of the company's quarry to the tracks of the Michigan Central, Pere Marquette and D. U. R. Secretary H. N. Snyder, of Detroit, testified the distance to the former was but two and one-half miles and to the latter two miles.

The rate was similarly increased on interstate shipments. It is likely an appeal will be made also to the interstate commerce commission. The Lake Shore is the only road that has a side track in the company's quarry.

ARTHUR A. STADE SUCCEEDS AS CEMENT SALESMAN.

As might be expected, when a vacancy occurred in the sales force of the Chicago Portland Cement Company, a young man, in whose name the symbol of this company is embodied and who is doubly fortified with an excellent record both as a practical lumberman and as a salesman, was given an opportunity to demonstrate his ability.

Arthur A. Stade, or "Double A" Stade as he is now known, whose early training among the lumbermen of the great Northwest is interesting, deemed it advisable to return to Illinois and incidentally seek to become identified with a young and growing industry, one in which his enthusiasm might find ample scope. His services were promptly accepted by the Chicago Portland Cement Co. and after a few weeks preliminary work in the general offices of the company, during which he readily adapted himself to his new surroundings, Southern Illinois territory was assigned him.

Mr. Stade has just celebrated his twenty-fifth birthday. Born and reared in Chicago, he graduated from high school in the year 1906, and shortly after entered the employ of the Leech Lake Lumber Co. well-known lumber manufacturers of Northern Minnesota in the humble capacity of box factory time-keeper.

His ability was early recognized, the appointment of shipping clerk and that of assistant foreman, being conferred upon him in rapid succession. Leisure time he devoted to the study of forestry and to the manufacture of lumber, which subsequently proved of great benefit to him, upon his entering the practical end of the business one year later.

Following his assignment to one of the company's numerous lumber camps, he undertook such work as timber scaling, tallying and participated in the spring drive of the company, transporting the logs through the rivers to the saw-mill and which latter work always remains a source of enjoyment even to the veterans in the business.

He next turned his attention to practical work around the mill, operating at intervals, a variety of machines, piling and finally grading lumber and having thus acquired a good knowledge of the business, he started on his career as a salesman.

His connection with the Chicago Portland Cement Co. dates back to May of last year and his earlier training has been such as to fit him admirably for the work that lies before him.

MR. ARTHUR A. STADE.

In the brief interval of seven months, Mr. Stade has already made many friends for his company, among the lumber dealers of Southern Illinois.

CONCRETE WITHOUT MOLDS.

"Ornamental Concrete Without Molds," by A. A. Houghton, is the title of a new book just placed on the market. It is explanatory of a system of molding ornamental concrete units with templates; contains additional information on the proper preparation of concrete for ornamental work, and proportionate size of the various units and the reinforcement of work; contains everything that a concrete worker needs to know to perfect the many styles of ornamental concrete work without the purchase of molds, and is intended for the concrete worker and contractor of small means or who cannot afford to purchase molds for the many various styles of work he is called upon to do, as well as for the artistic workman who wants a surface that is perfect.

Copies of the book may be secured from Cement & Engineering News, Schiller Bldg., Chicago, on receipt of price, $2.00.

Among The Cement Mills

CEMENT MANUFACTURE IN NEW ZEALAND.

The Wilson Portland Cement plant at Warkworth, New Zealand, is working on the "dry" system, the works being situated on the banks of the Mahurangi River, about 40 miles north of Auckland. The cement raw material deposits extend over an area of 800 acres, all owned by the company. The cement rock is very nearly the correct cement raw mixture, containing from 73 to 76 per cent carbonate of lime.

The raw material is first stored in bins, analyzed, passed through an 11-foot pan mill, when the necessary additions of lime or clay are made; then through a rotary rock drier; then elevated into storage bins of 600 tons capacity over the raw mills, these being 33-inch Fuller mills and contained in a concrete building; the mixture is stored in tanks behind the rotary kilns, large enough to supply the kilns for 48 kiln hours. The rotary kilns are of Allis-Chalmers manufacture, two 60x6 feet and one 100x8 feet, producing about 800 tons per week. These also are contained in buildings of concrete and iron construction. The clinker, after being passed through a rotary cooler, receives the necessary admixture of gypsum and is crushed by rolls which reduce it to a fineness of three-quarter inch. The preliminary grinding is done by Kent mills, the fine being separated by "Vibracone" separators. The finishing is done by 22x5 feet tube mills. The packing is all done by hand; the finished cement is shipped in jute bags. The power is obtained from a battery of seven boilers, two compound engines of 400 horsepower each, and one of 750 horsepower. The power is transmitted by means of ropes and belting.

The plant is lighted by electricity, derived from a small engine and dynamo. Attached to the plant is a repair shop, in which practically all machine work can be done. The testing is carried out by a chemist and an assistant.

SOUTH AFRICAN CEMENT INDUSTRY.

Investigations have been in progress to ascertain the possibilities of a cement factory in the district of Mossel Bay. Options have been purchased of a considerable tract of land, and experts have been conducting experiments. These agents have returned to their principals, who represent large interests in England and Germany. Their return to the scheme of operations is shortly expected, and from reports it seems likely that an industry will be established.—South Africa.

A movement is on foot to establish a Portland cement factory in Bulawayo. A company is now in course of formation in connection with the enterprise. The promoters of the scheme have secured rights from the Government over an area on the Tuli Road, which is about fourteen miles from town, containing enormous deposits of material said to be suitable for the manufacture of high-grade Portland cement. From exhaustive tests which have been made, it is claimed that the cement is equal to the best imported. "Expert evidence," says the Rhodesian Mining Review, "is particularly sanguine as to the importance of the discovery, and the promoters are confident that it will lead to the establishment of an important industry in Bulawayo." Application has been made to the Town Council for a site in which to erect the factory.

There have been rumors of the cement plant at Bronson, Mich., starting to run again, after a number of years' idleness, but investigation proves the reports untrue, although a proposition for selling out the factory has been considered by the directors. The wet method of manufacturing the product as employed here, says the Jackson, Mich. Daily News, is said to be much more expensive than the dry plan used in other factories. Offers for the purchase of the factory have been received from western parties, and it is anticipated the mill will be sold in the near future. A number of Bronson people have large investments in the factory.

The Sandusky Portland Cement Plant at York, Pa., that had been closed down for the past three months, has resumed operations. During the time the plant was idle additional machinery was installed and other improvements were made. With the increased facilities. The capacity of the concern was enlarged considerably.

The Denver and Rio Grande railroad and the Colorado and Southern railroad were indicted by the Federal grand jury, charged with granting rebates and with issuing free transportation to influence interstate shipments.

The Colorado Fuel and Iron Company, Victor American Fuel Company, Great Western Sugar Company, Portland Cement Company, and United States Portland Cement Company are indicted, charged with accepting rebates and free transportation.

Ernest Ashton, chemical engineer of the Inland Portland Cement Company, Metalline, Wash, recently left for Germany, visiting Chicago, Allentown and New York en route. Mr. Ashton will make a study of the German cement industry.

Mr. Ashton will also visit the cement factories of England.

"The manufacture of Portland cement in the United States has made such rapid development that little attention has been paid by our manufacturers to the actual chemical composition and exact nature of the changes that take place during its manufacture," said Mr. Ashton today. "The Germans have made a thorough study of this and are, therefore, in position to offer the best knowledge possible based on scientific investigations.

"As a result of my investigations in Germany I hope to return home with knowledge which will enable our company to offer every possible advantage to the cement users of the Inland Empire."

Mr. Richard K. Meade, the well known cement and lime expert, announces that he has opened offices and laboratories at 202 North Calvert St., Baltimore, Md. Mr. Meade will make a specialty of the design and construction of lime and cement plants and of reports on lime and cement propositions and properties. He is also prepared to make tests and analyses of lime and cement and to advise manufacturers relative to the improvement of their plants, process or products.

Among The Cement Mills

STOCKHOLDERS' MEETING.

Tuesday of this week was the occasion of the annual meeting of the stockholders of the Dakota Portland Cement Company of Chamberlain, S. D. The meeting was attended by twenty-five members representing about one hundred and fifty thousand dollars of stock which has already been sold by the company. The session was one of the most satisfactory ever held and indicated that a spirit of good feeling prevailed in the organization and its stockholders and that the people behind the movement foresee a prosperous future with considerable assurance that all minor details can be arranged so as to commence further operation on the construction of the plant and complete it in the near future.

Arthur Hill was chosen president; J. Q. Anderson, vice-president; E. E. Dye, secretary; E. F. Scott, N. W. Eggleston, C. J. Bock, A. M. Shon, B. H. Tohmas and A. J. Schmit as directors. Messrs. Hill, Bock and Dye are members of the executive committee. The personnel of the officers places the control in the hands of the Chamberlain people, who are interested heart and soul in the final completion of the plant. It was the unanimous sentiment of the stockholders that a majority of the board of directors be alloted to Chamberlain and that the president be a Chamberlain man. This for the reason that the men on the ground are better able to devote their time and oversee the management of the plant more satisfactorily than men from any great distance. This is indeed a good move and the men who have been elected represent the most active business men of the city. They are men possessing a wide range of experience, men of business integrity and command confidence, and will spare neither time nor patience in making the plant a success. It is pretty safe to say that if the plant had originally been promoted by home people that the plant would today have been in operation and doing thousands of dollars worth of business every year.

A committee was appointed to make further examinations of the lignite coal fields of North Dakota for the purpose of securing the coal supply for the plant. It was the consensus of opinion that if a contract could not be closed with regular miners that steps be taken to secure this coal through some other source. It has been demonstrated that a greater intensity of heat can be secured from a quantity of lignite than from the same amount of regular steam coal ordinarily used for manufacturing purposes. In addition to this feature is the lower original cost and the Missouri affords a splendid inducement for water transportation in case railroad rates prove unsatisfactory.

The plant will probably be incorporated under the South Dakota statute instead of the West Virginia law, under which it was originally organized. Chamberlain people feel highly pleased over the results of Tuesday's meeting. It is fairly possible that it will be completed this year; it will be remembered that considerable work has already been done and that the main building is now partially completed.—Cham. News.

The Waukegan Pressed Stone Company, Waukegan, Illinois, announces that it will build a new plant in the spring to cost $10,000. Charles H. Pence, is president of the company.

CUBA BIG USER OF PORTLAND CEMENT.

Within the last decade Portland cement has become a very important item in Cuba's import trade, says the Consular Trade Report. Its usefulness in tropical countries is demonstrated in many ways, and this is especially true of the conditions in Cuba. On account of the lack of cheap building lumber and municipal building regulations, most of the houses in Cuban cities are constructed of stone, brick, and mortar, or a mixture of broken stone and mortar.

While these building materials are still used to a great extent, each year notes a considerable advance in the use of cement and concrete for houses and large buildings. A considerable portion of the imported cement is used in constructing docks, street pavements, sidewalks, curbstones, floor tiles, and for ornamental work of every description. Certain Cuban artisans have acquired great proficiency in working up cement imitations of stone, tree trunks, and even plants and leaves. Tints are used to imitate the colors of the subject and the effect is generally very attractive.

In one of the suburbs of Havana there is a typical thatched-roof Cuban hut made entirely of cement and stone. The work is so cleverly executed that it is difficult to distinguish it from the original. The value of this interesting work, however, is confined to its ornamental usefulness.

Cuban Floor Tile.

The manufacture of Cuban floor tile consumes a large amount of cement, hence the yearly increase in business. In this connection a brief description of the Cuban floor tile and its manufacture may be interesting to manufacturers of similar material in the United States, Cuban floor tile is 8 by 8 by ¾ inches in size and is made in solid colors and in regular patterns of different colors; it is made by either a European or an American hydraulic tile machine which turns out one, two or four tiles at each operation. The colored cements are placed in the machine by hand and are kept separate by a design or pattern made of thin steel.

TO ADD TO CAPACITY OF CEMENT PLANT.

In order to add to the capacity of the Ragland, Ala., plant 600 barrels of cement per day it was announced yesterday that approximately $75,000 would be expended by the Atlantic and Gulf Portland Cement company at once.

This company, it will be recalled, some months ago caused a receiver to be appointed for the purpose of straightening out some affairs of the company. It was given out yesterday that the company's affairs are now in first class shape. It is expected in local industrial circles that the receiver will be dispensed with just as quickly as the legal formalities and business conditions permit.

The officials who have been in charge of the Ragland plant are very optimistic over the general conditions and their faith in business in this section is emphasized by the additional increase in capacity which has been authorized.

L. L. Griffiths, formerly general superintendent of the Texas Portland Cement Co., is now manager of the Tidewater Portland Cement Co., Union Bridge, Maryland.

Among The Cement Mills

Edmonton Portland Cement Company, Ltd., Marlboro, Alberta, Canada write us that they are looking for a first class cement mill superintendent to take charge of the operation of their new mill and also act as resident manager. They would like to hear from some one of good experienc in the wet marl process. They have a modern plant, 1,800 barrel capacity.

Hal H. Smith of Detroit is before the state railroad commission Lansing, Mich., asking protection for the cement industry of Michigan against the steel trust, which, it is alleged, is benefiting by a lower freight rate on cement than is granted to Michigan cement plants. The particular case is based on complaint of the Newaygo cement plant which, it is alleged, is discriminated against in a new cement tariff issued by the Pere Marquette. It is alleged that the tariff contains 147 increases and 37 reductions as applied to cement shipped from that plant while the tariff sheet grants the steel trust cement plant at Bluffington, Ind., 199 reductions on Michigan shipments and one increase. Mr. Smith states that as a result shipments of steel cement into Michigan have greatly increased while the business of Michigan plants has fallen off 5 per cent and some plants in the state are being forced out of business.

As a first step to resumption of business by the American Cement properties, which are being reorganized as the American Portland Cement Company, Charles F. Conn was yesterday elected president of two operating companies in place of John W. Echert.

In carrying out the reorganization plan all mortgages on the various plants will be foreclosed and the properties or equities will be bought in at public sale for the new corporation to perfect the titles.

C. M. Dugan, Jr., for the past seven or eight years general manager of the Kosmos Portland Cement Company in Louisville, has retired from that position and left for New Mexico, where he will be identified with the Southwestern Development Company.

Charles B. Horner, of Philadelphia, who is widely known in Louisville, has succeeded Mr. Dugan as general manager of the cement company. He already has moved to Louisville and has taken up his residence here.

Mr. Dugan's resignation was partly occasioned by ill health, his physicians having recommended a change of climate. In New Mexico he will devote his attention to his interest in the Southwestern Development Company, which concern he recently organized with other local men. Mr. Dugan is president of the company, which is at present engaged in developing the town of Des Moines in New Mexico.

Friends of Mr. Dugan and officials of the company with which he was connected here presented him a solitaire diamond ring just before his departure as a token of affection.

Cementos Hidalgo, S. A., Hidalgo, N. Leon, Mexico, writes us as follows: "We are in need of two first class cement burners and would pay good wages to proper parties. We have four 100 ft. kilns and use crude petroleum for the burning of our materials. Our plant is located 25 miles from Monterey, the largest city in Northern Mexico, and we have never had any trouble here.

A large force of mechanics have been changing the engines and other machinery of mill "A," the oldest of the Lehigh Portland Cement Company, Allentown, Pa. This improvement will require several months for completion.

The mills of the Coplay Cement Manufacturing Company, Coplay, Pa., now under new management, have enjoyed a banner year. They are now equipping their quarry with an immense crusher and also another steam shovel.

The cement plant of J. B. Speed & Company, Louisville, Ky., has been closed down for the winter and is being put in shape for the coming spring. Henry Gray, secretary of the company, reported that 1912 was a satisfactory year in every respect.

The plant of the Kosmos Portland Cement Company, Kosmosdale, Ky., after a week's close down, has resumed operations and will probably run steadily until spring. C. M. Dugan is manager of the plant.

The Phoenix Portland Cement Company, Nazareth, Pa., has increased its capital stock from $400,000 to $750,000, and will use the money to enlarge and increase the capacity of the plant.

The county road commissioners of Wayne county, Detroit, Michigan, opened bids for about 100,000 barrels of Portland cement for the season of 1913, the lowest bidder being the Universal Portland cement company, at $1.08 a barrel net.

The Canadian Equipment & Supply Company, of Calgary, who have the Alberta sales agency for the Inland Portland Cement Company, of Spokane, report the importation of over 25,000 barrels of American cement for consumption in Calgary. Although this represents their total imports, they anticipate an increase during the month of July when the effect of the reduced freight rates north will begin to allow them to compete in Edmonton. The freight rates north and south have allowed American cement to compete with the Canada Cement Company in Lethbridge, so that the cement manufactured in Calgary has been shipped south and sold in Lethbridge for a lower price than could be had in Calgary. Yet here in Calgary, even with half the duty off. American cement is sold for 15 cents a barrel more than Canadian cement. The Canada Cement Company continue to quote $2.70 a barrel in Calgary for cash payments (20 days), while American cement is quoted at $2.85 a barrel, freight and duty in advance, balance within 30 days. These prices are for barrels of 350 pounds. From this it will be apparent that in Calgary at least it is more a question of prompt delivery than of price, and since the cement must have been imported in order to proceed with construction, it is seen that lowering the duty has prevented considerable loss to the contractors, who even now must pay an advance of 15 cents on the barrel in order to get deliveries. Which brings to mind the fact that so far no complaint has been made as to delays in carriage from Washington, all of which is done by the Canadian Pacific.

Stephen Quinn, formerly chief engineer of the Iola Portland Cement Co., Iola, Kan., has accepted a similar position with the Knickerbocker Portland Cement Co., Hudson, N. Y.

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Among The Cement Mills

TEXAS CEMENT PLANTS.

Attorney General James D. Walthall, Austin, Tex., has abandoned his efforts to secure the appointment of a temporary receiver for the four cement concerns named as defendants in the suit for ouster and $7,600,000 penalties for alleged violation of the antitrust statutes. One company, the Texas Portland of Dallas, has gone into involuntary bankruptcy proceedings in Dallas, and as to the other three Mr. Walthall frankly admitted today that he could not make a showing which would authorize the court to appoint receivers therefor. The three concerns are the Southwestern Portland Cement Company, the Southwestern States Cement Company and the Alamo Cement Company.

This was the day fixed by District Judge Wilcox to hear argument in response to the state's petition for temporary receivers but having come to the conclusion that the requisite showing could not be made, Mr. Walthall notified those concerned that it would be unnecessary for them to appear or be represented as he would not press his plea for receiverships. Thus there was no hearing held, but the temporary injunction granted forbidding the removal of papers and records and the secreting of books, etc., remains in force. There can now be no developments until the day the case comes to trial, and as yet that has not been fixed.

The allegations in this suit as to the combination fixing the prices of cement in this state on the Kansas City-Galveston basis with the same quotations in East Texas towns heretofore has been amplified in these dispatches.

Judge Wilcox has modified the injunction so as to permit the Southwestern Portland Cement Company of El Paso to do interstate business, but the company is to return the proceeds of the sales to the state and keep them there until the litigation ends.

PORTLAND, ORE., A CEMENT CENTER.

Because of the great future development in prospect for the use of cement in building and road construction throughout the States of the Pacific Northwest, the headquarters of the recently formed Association of Western Portland Cement Manufacturers have been removed from San Francisco, Cal., to the more central business point of Portland, Oregon. Mr. Percy W. Rochester is secretary, with offices in the Northwestern Bank Building.

MICHIGAN CEMENT COMPANIES FILE PROTEST.

The Peninsular Portland Cement Company of Jackson, the Wolverine of Coldwater, the Omega of Moshcrville and the Aetna of Detroit, have filed a protest with the state railroad commission against the increase in rates which several roads have announced to become effective March 1. The companies complained against are the Grand Trunk, Pere Marquette, L. S. & M. S., Michigan Central, D., T. & I. and D. & T. Short Line.

The cement companies claim the proposed rates will practically put them out of business in Michigan. The commission has suspended the rates for six weeks and has granted the railroad and cement companies a hearing.

MARQUETTE CEMENT CO.

The annual meeting of the stockholders of the Marquette Cement Manufacturing Company was held January 28, 1913, at the general offices, La Salle, Ill., at which time the following officers were elected:

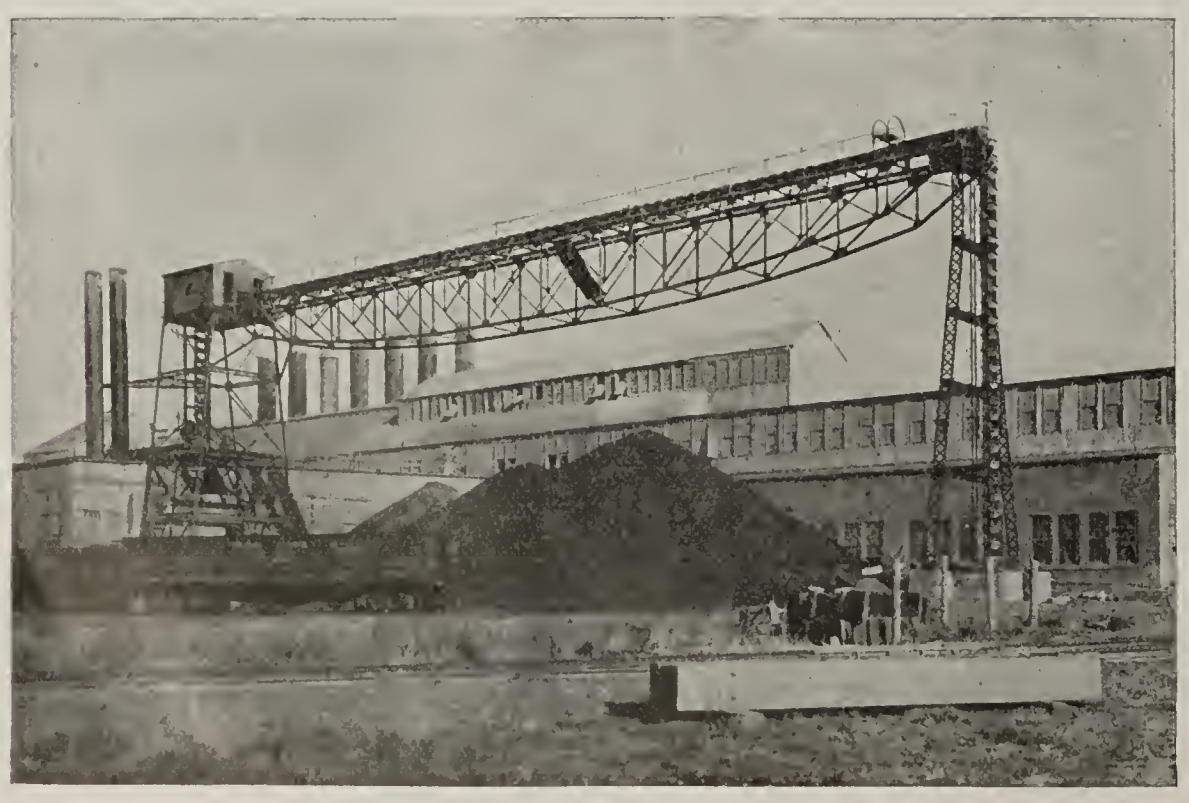
N. W. Duncan, chairman of the board.
T. G. Dickinson, president.
William Dickinson, vice-president.
Stuart Duncan, treasurer.
E. J. Dalton, secretary.
Gold Williams, sales manager.
Robert B. Dickinson, assistant to president.

The usual dividend of 8 per cent was declared and other routine business transacted.

1913 CEMENT DIRECTORY.

"The American Cement Directory" for 1913 is now off the press and ready for distribution. It is the most up-to-date complete directory of cement mills ever compiled and is well worth the price, $1.00.

The book is bound in flexible leather and contains valuable information concerning cement plants in the United States and Canada; giving the capacities, makes of machinery, list of officers and number and size of kilns, etc. It is published annually by the Bradley Pulverizer Company, Boston, Mass.



"Peck" Carrier, height 70 feet, span 160 feet, conveying clinker to storage, at the Chicago Portland Cement Company's plant. Kiln building and finishing mill in background. This conveying equipment was manufactured by the Link Belt Company, Philadelphia and Chicago.

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By the Quality and Quantity of Drain Tile it will turn out right in *your own plant*

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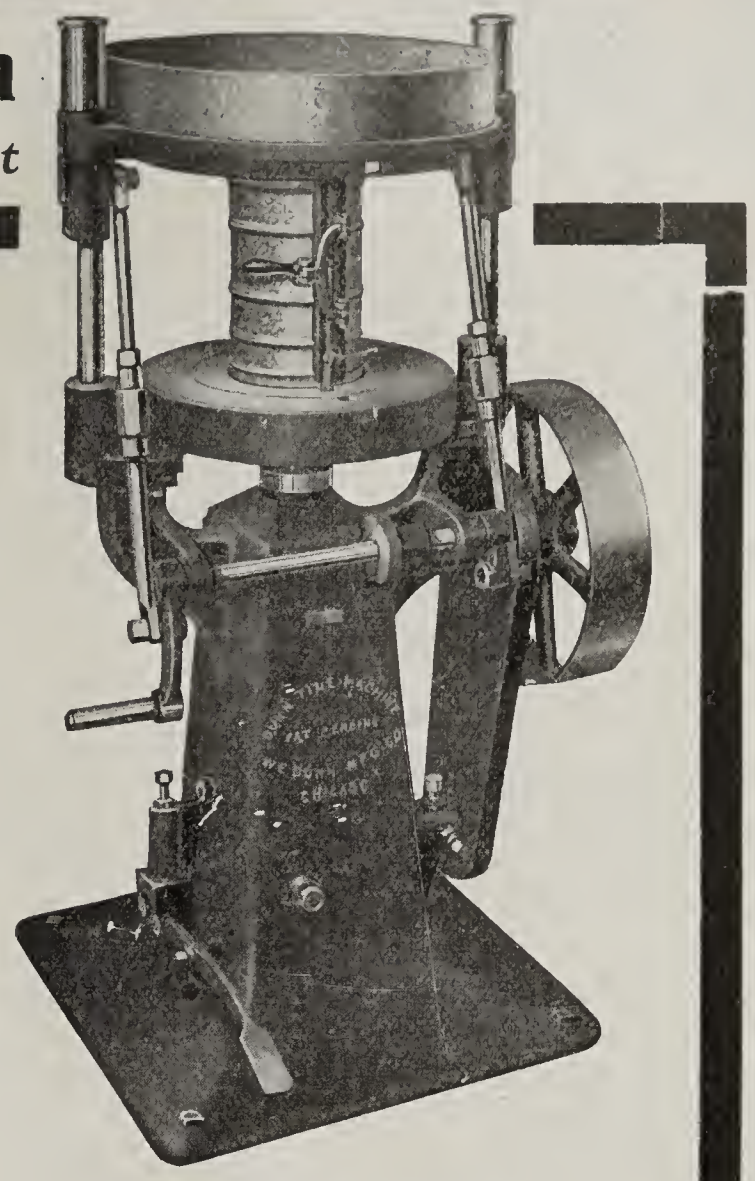
Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.



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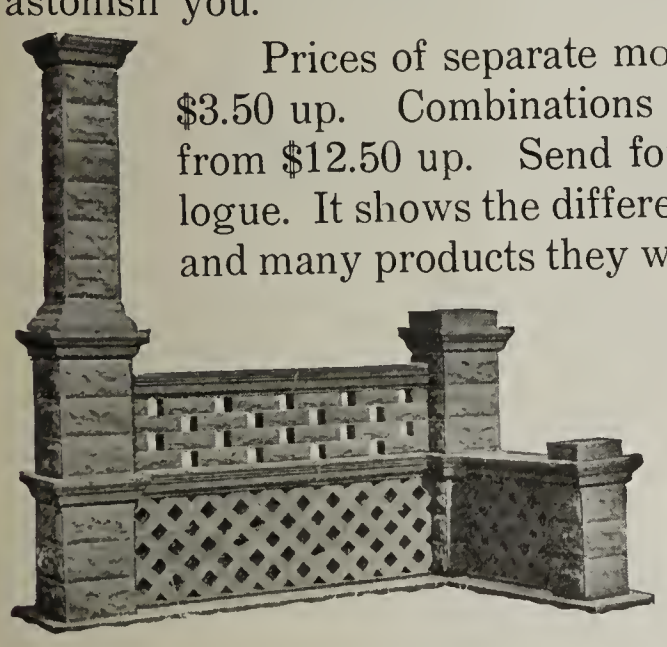

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No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

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Among the Cement Mills

CHOCTAW PLANT NEARING COMPLETION.

The Finishing Mill Consists of a Battery of Five Giant Griffin Mills.

The new plant of the Choctaw Portland Cement Works at Hartshorne, Okla., is nearing completion. The plant is situated in the coal fields of Hartshorne, the nearest mine being one-half mile distant on the spur leading to the plant. The rock lies in a ridge 200 feet above the plant, and as the overburden has been eroded no stripping is necessary. The drilling is done by a well drill breaker, holes being put in by small drills and the boulders broken by hammer drills. The rock is loaded by a Marion steam shovel into 6-yard cars, which deliver the rock to the crushing plant situated on a level with the quarry floor.

The crusher plant consists of No. 8 and No. 6 gyratory crushers. Two and one-half yard cars on a continuous cable run underneath the bins and over the Rock Island Railroad tracks to the raw grinding department of the cement mills. At the present time all of the output of the quarry is being loaded into the Rock Island cars for ballast.

The shale lies adjacent to the stone and is loaded and carried to the plant by the same rig and tram. The entire plant is exceedingly well designed, being very compact in the arrangement. The process of drying, pulverizing, burning, final grinding, together with the generation of all power, takes place under one roof. The drying equipment consists of two 6x60-foot dryers. The raw pulverizing is done by two ball mills, and one 8x26-foot tube mill. The two kilns are 8x110 feet, cooler 6x50 feet. The finishing mill consits of a battery of five Giant Griffin mills.

The power equipment consists of two 500 horsepower boilers, placed in the rear of the kilns to utilize the waste heat, two 200 horsepower boilers and two 750 K. W. turbines. The entire plant is electrically driven by individual motors. All elevators and conveyors are of steel and steel cased and standardized, thereby lessening the repair parts kept in store.

The stock house is built of reinforced concrete 60 feet wide, 140 feet long and 25 feet high, with steel trusses and corrugated steel roofing. The packing room is 15x140 feet. The machine shop building is 40x100x20 feet to the eaves, and houses machine shop, blacksmith shop and store room. The coal mill is 34x118 feet, and contains 6x60-foot dryers and three 30-inch Griffin mills. The powdered coal is carried by screw conveyors over a steel bridge to small storage bins immediately in front of the kilns. The clinker storage bin and the stock house building are reinforced concrete. The other buildings are of steel frames with Portland cement walls on metal lath. All of the buildings are floored with concrete and roofed with corrugated steel. No wood has been used in the construction. It is an absolutely fireproof plant.

Water is furnished gratis by the city of Hartshorn from the reservoir 160 acres in extent. On account of the enormous strength of their cement it has been named Elephant brand.

The directors are as follows: C. B. Blake, president and general manager; B. E. Allison, vice-president; J. B. Westbrook, vice-president; E. H. Jayne, treasurer; D. W. Keller, secretary; N. E. Tuell, E. T. Kirk, H. J. Serwinsky, F. W. Freeborn.

SUIT IN CEMENT DEAL.

The suit of the Equitable Trust Company of New York against the National Bank of Commerce of St. Louis, filed in the United States District Court, for $159,000, alleged to be the balance due on a note involving the Iola Portland Cement Company, is welcomed by the representatives of the bank, as it will be the means of clearing up a transaction for which the Bank of Commerce directors say the institution was not responsible.

The petition recites that the loan was made originally in January, 1907, by the Bowling Green Trust Company of New York to J. W. Perry, and indorsed by George E. Nickerson and A. B. Cockrill of the Iola, Kan., Portland Cement Company.

Perry is named as being assistant to the president of the National Bank of Commerce in the transaction. The Equitable Trust Company of New York has since absorbed the Bowling Green Trust Company.

The loan of the Bowling Green Trust Company was secured by stock of the Iola Portland Cement Company, which the petition says, the National Bank of Commerce assured was of the highest form of security.

In July, 1912, the petition states, the National Bank of Commerce charged off from its assets about $1,000,000 of loans made to the Iola Portland Cement Company.

The trust company alleges Nickerson and the bank with Perry as its agent, on January 17, 1907, entered into a secret agreement by which the bank was to attempt to buy from the owners of the stock in the Iola Cement Company, their holdings at $25 a share. The trust company alleges the bank agreed to advance part of the money for the purpose and promised to procure the remainder by obtaining loans from other financial institutions.

George L. Edwards, counsel for the National Bank of Commerce, says that the fact that the trust company did not until recently hold the bank liable, is proven by its practice of requesting statements from the Iola company on the value of its collateral. It would not have done this, Edwards says, had it relied on any obligation of the bank to procure the payment of the loan.

"I believe the trial of the suit will show the trust company loaned its money to Nickerson and Cockrill on the same kind of collateral as that upon which the bank loaned Nickerson large sums," said Edwards. "It was for the same purpose and was with the same information. The bank is in no way liable for payment of the loan and has in no way misled the trust company."

CORRECTION.

In our issue of November, 1912, we stated that the car dumper which is used for handling standard capacity cars for discharging rock from same into the mammoth crushers at the Iowa Portland Cement plant at Des Moines, Iowa, was manufactured by the Brown Hoisting Machinery Company. The car dumping equipment is patented and is manufactured by the McMyler Interstate Company of Bedford, Ohio, and not by the Brown Company.

THE WINNER

THIS IS the latest innovation in the eighth yard mixer world and it is a "winner" from the word GO. It loads or discharges from either side, has plenty of power, is built strong and durable and will turn out satisfactory concrete wherever you put it.

Our catalog "Money-Making Mixers" showing this machine as well as several other styles and kinds is free for the asking.

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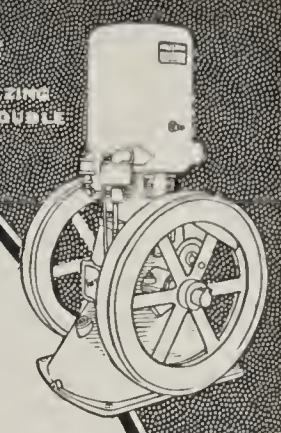

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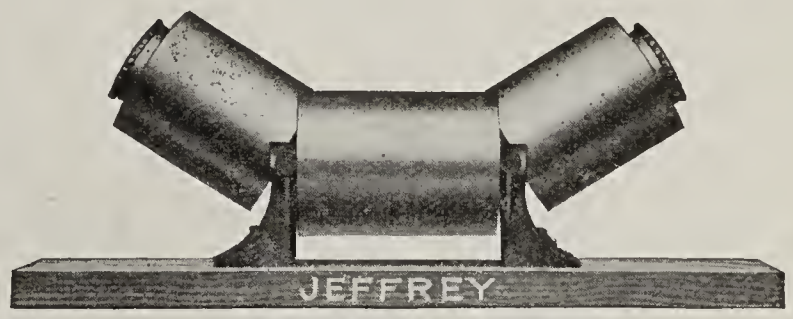

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Pulleys are offset and overlap so that the belt is not pinched and the edges are not cut. They are exceedingly strong, light in weight and perfect self-oiling.

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A VALUABLE WRINKLE IN MUDCAPPING.

By G. F. Lord.

After firing a large shot in a quarry there is nearly always a quantity of rock thrown out in large blocks which are too large to handle and which have to be broken up again by small charges of explosive. They frequently fall on the quarry tracks and have to be broken up and removed immediately.

The best equipped quarries break up practically all their loose rock by firing small charges in short holes drilled with a hand or pneumatic hammer drill. In soft, easily drilled rock, this is by far the most economical method and is quick enough for most practical purposes, although with very hard rocks especially those which are also brittle, it is often cheaper to mudcap than to drill. A great many quarries mudcap all the rock which is thrown so far from the face that the air pipe connected to the hammer drills will not reach. It has been found during experiments with the new Red Cross straight dynamite, that using the same charges of dynamite on equally resistent rocks, the position of the blasting cap or electric fuse made a very appreciable difference. It was found that when the blasting cap was placed near the rock, the results were quite inferior to those obtained when the blasting cap was placed as far away from the rock as possible still keeping it buried in the dynamite. The reason for this, is that with this style of blasting, it is primarily the quickness of the blow that counts and any explosive wave requires a certain distance in which to "pick up" its full speed.

When the blasting cap is placed down close to the rock the dynamite in that vicinity does not explode with as great force as it does at the top of the charge, which is in contact with the mud or sand, but when the cap is placed just beneath the surface of the dynamite, that portion in contact with the rock explodes with the greatest energy and does noticeably better work.

It was also noted that other conditions being the same, mudcap charges which were taken out of the wrappers and made in a pile at least 1 inch deep and covered with paper from some of the wrappers, cracked the rock better than the same charge placed on the rock in the original cartridges. The new Red Cross Straight Dynamite, of 45 per cent strength and upwards, have been found to be better adapted for this work than other grades and almost everything the most exacting quarrymen can wish for mudcapping work. Although they are low freezing explosives, they possess the quickness and snap desired for this class of work in as great a degree as the old time Straight Dynamites.

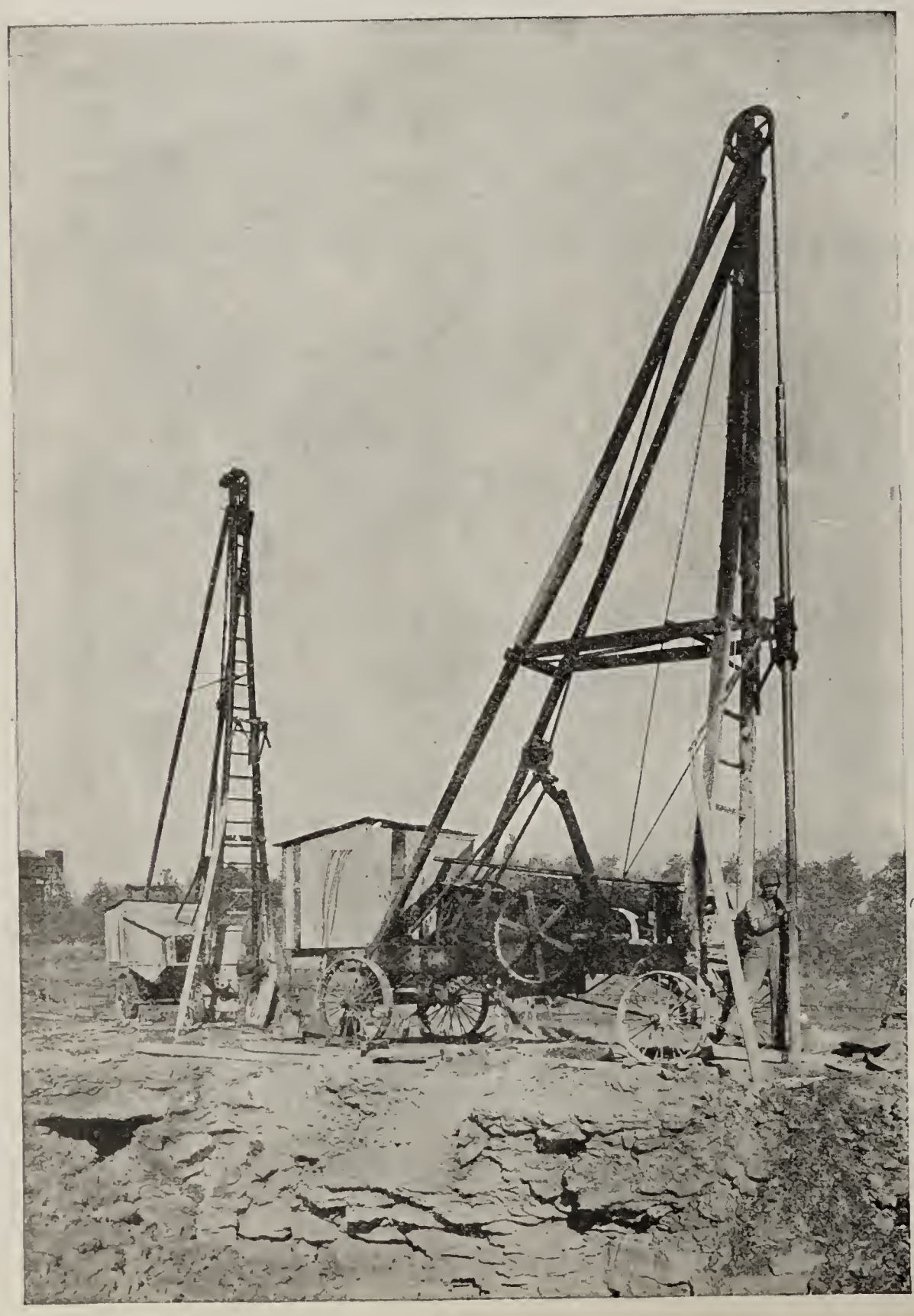
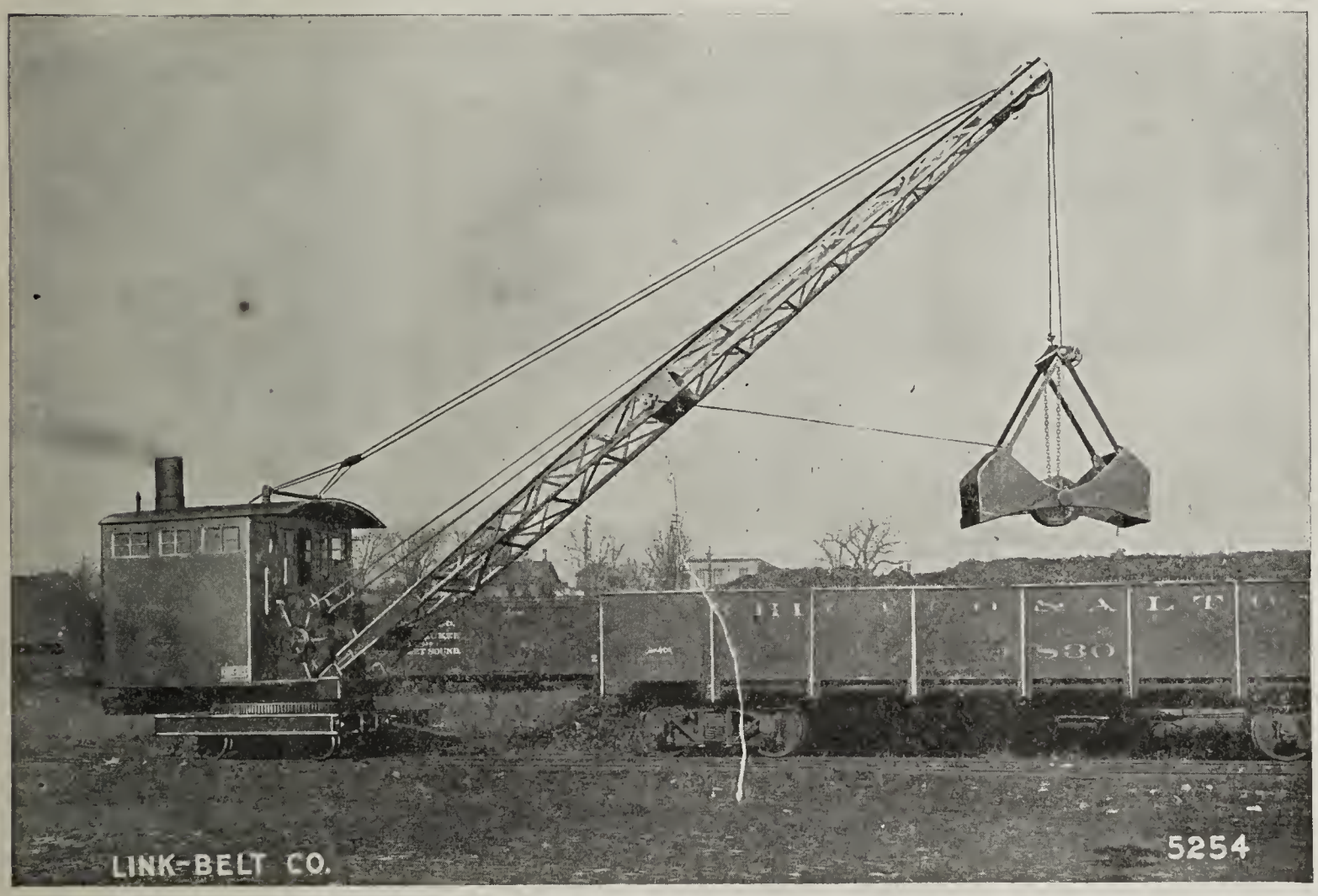


Illustration shows the churn drills at work on the rock ledge preliminary to blasting in the quarry of the Chicago Portland Cement Company. After drilling, the holes are loaded with special dynamite cartridges sufficiently heavy to shatter the ledge without overthrowing or casting it out.

4/13

CEMENT
... AND ...
ENGINEERING NEWS



THIS ILLUSTRATION SHOWS THE NEW 15-TON STANDARD GAUGE LOCOMOTIVE CRANE.

Manufactured by the Link Belt Co., Chicago and Philadelphia.

This machine has been designed especially for grab bucket work, which is the hardest and most continuous service to which locomotive cranes are subjected.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

Advertising Rates Sent on Application

JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, APRIL, 1913

IMPROVEMENTS IN CONCRETE CONSTRUCTION.

Half a century ago concrete construction was an art understood by comparatively few. It became accessible to most architects only in the course of time after a thorough study of the underlying principles. Today the splendid results achieved in concrete in all branches of architecture convince the most skeptical that the combination of steel and concrete has come to stay and that it has many attractive and economic features.

There have been failures in concrete construction, to be sure. This is unfortunately the case in the development of every craft. It may be even admitted that accidents in concrete construction have been especially numerous as long as laymen were allowed to practice the profession. Since the advent of modern building codes, however, careful supervision is exercised in all construction work, so that failures will become less frequent from year to year.

The efforts of the past decades were directed towards the study of mechanical features, that is to say, towards the determination of the working of the unison of steel and concrete in tension and compression. These led to a universal method of concrete construction, the standards for which were embodied in the building codes adopted by the various countries which were foremost in the profession.

However, this standardization of the methods of building alone did not satisfy the modern engineer. He invaded new fields of usefulness and directed his attention, in recent times, mainly to the adornment of his creations and to the prevention of the numerous unsightly features which accompanied concrete construction heretofore.

Our modern literature, therefore, is rich in contributions aiming at beauty and gracefulness in concrete construction. It contains many valuable hints how to overcome blemishes that for a long time were supposed to be necessary evils of concrete construction, as for instance the formerly unavoidable cracks and fissures in concrete walls and concrete stucco. The builders who succeeded in mastering these obstacles deserve, in our opinion, great credit for their painstaking work, as through their efforts the host of antagonists of concrete construction will be materially diminished.

Step by step we thus approach the era when concrete construction will become known not only for strength, economy and durability, but also for architectural beauty of its own combined with all the charms of exterior decoration demanded of other building material.

BELIEVES FERTILIZER MADE FROM CLAM AND OYSTER SHELLS WILL PROVE FARMERS' AID.

Prof. H. W. Parks, of the Washington State college, Pullman, Wash., announced that he has been investigating to find a source to furnish limestone to farmers of Washington at a reasonable price. As a result of his investigation he has found the shores of Puget Sound to be rich in clam and oyster shells, which, when pulverized, are inferior to none as a fertilizer, he says, as they are composed of lime of the purest quality.

He is now planning the installation of machinery to dredge for and screen the shells. The transportation companies, he says, have promised a rate on this line for fertilizer of one-half of the regular fourth-class freight rate. Mr. Parks estimates that the lime can be delivered at a gross price of $2 a ton.

In explaining the necessity of securing some source for a supply of lime, Mr. Parks said: "Western Washington soils are deficient in lime, and in many places there is an excess of organic matter, resulting in acid soil. It is a well established fact in agriculture that many of our best crops, especially the legums, (clover or alfalfa family) will not thrive in these acid soils. There have been many attempts in Western Washington to grow alfalfa which have resulted in failure. I believe this to be due principally to the deficiency of lime in the soil.

"There are but few known lime deposits in Western Washington. All that are known are in the hands of industrial corporations which use the lime for industrial purposes. Large amounts of lime are needed to neutralize the acid in the soil, the ground limestone being the best for agriculture."

STATEMENT OF OWNERSHIP, ETC., FOR POSTAL AUTHORITIES.

Statement of the ownership, management, etc., of Cement & Engineering News, published monthly at Chicago, Ill., required by the Act of August 24th, 1912.

Note—This statement is to be made in duplicate, both copies to be delivered by the publisher to the postmaster, who will send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the Postoffice.

Publisher, Editor, and Managing Editor, William Seafert, Chicago, Ill.

Business Manager, J. F. Waldron, Chicago, Ill.

CEMENT & ENGINEERING NEWS is not incorporated; it is owned solely by William Seafert; residence, 435 S. Marshfield Ave., Chicago, Ill.

There are no bond holders, mortgagees, or other security holders outstanding against Cement & Engineering News.

Sworn to and subscribed before me this eighteenth day of March, 1913.

(Seal) ROBERT A. CLARA, Notary Public.

(My commission expires Aug. 17th. 1913.)

SOME NOTES ON CAUSES OF FAILURE OF STUCCO WORK.

By A. G. Cutting, New York, N. Y.

A number of years ago stucco was quite generally used in certain localities, but owing to failures of the material to withstand the action of the elements and to other causes, this type of construction was almost entirely abandoned. During the last few years, however, there has been a very marked tendency by the building public to take up this class of construction again, therefore this word of caution.

We do not want to have the same experience with this type of construction, as the concrete block industry has had, and yet unless due care is used in drawing specifications and in their application, there are going to be a great many failures as in the past. Our architectural friends are very partial to stucco exterior, and if it is properly mixed and applied will come up to their expectations in every way. So much depends on the selection of the material, proper mixing and proper application that only skilled mechanics who are familiar with this class of work should be employed.

The writer has had opportunities to inspect a great many stucco residences in the past few years and is very sorry to say that the greater percentage of them are unsightly, due to cracks, discolorations caused by improper application, and lack of proper ingredient, etc. I wish to illustrate briefly by stating facts regarding two or three of the houses that have come to my attention.

I remember one residence in particular, where there were a grat many horizontal cracks in the stucco running almost the entire length of one side of the building. These cracks were about 2 ft. apart and were very pronounced. The whole area of sides and ends was very unsightly. After a very careful investigation it was found that in nearly every instance where cracks had developed that they were at a point where the wire lath was lapped and in many places less than ¼-in. thickness of stucco was over these laps. In some instances by cutting out the cracks it was found that the metal lath was not even tacked solidly in place, and yet stucco work in general was condemned by a number of parties on the results obtained on this one building. It was quite apparent that the trouble was not due to any fault of the material, but in this particular instance was due entirely to the application of the wire lath and stucco. In addition to the large cracks at the laps of the wire lath, there were a number of hair cracks throughout the entire area, which apparently were caused by too much troweling of the concrete mass, and as was found by investigation there was a coating or frosting of Portland cement on some of the areas and the cracks penetrated just through this frosting. Other areas were entirely smooth and cracks had not developed.

In another case regular lime mortar plaster without any Portland cement was used for the scratch coat. The second and finishing coat consisted of a poor mixture of Portland cement and sand. The finish coat was only about ¼-in. thick. Moisture penetrated through the finish coat and the mortar composing the scratch coat being subjected to continued moisture disintegrated and the stucco came off in sheets.

The third case was very similar to the second, although wood lath was used instead of wire lath on a small building near the sea shore. The scratch coat material consisted of regular interior plaster and the second coat consisted of Portland cement, asbestos rock and asbestos fiber. The second coat was very thin and the damp salt air and moisture penetrated through to the first coat. The lath became swelled and the stucco came off in sheets. The stucco on this work was condemned and the faults were laid at the door of the asbestos and Portland cement. Upon investigating the matter thoroughly, it was readily proven that the entire trouble was due to the nature of the lath and the materials entering into the first coat.

I have referred to these buildings with a view of cautioning people interested in stucco construction to see that this particular part of the building is given proper attention. In the past stucco has been applied in two coats, the total thickness being about ½ in. to ⅝ in. Past experience is teaching us, however, that 1 in. is by far better and if the material is applied in this thickness, house owners and architects should not have reason to regret its use.

Another point of considerable importance is the color. A uniform color is rather difficult to obtain on smooth surfaces particularly, but it can be obtained if proper attention is given to the selection and mixing of the ingredients and if the stucco is properly applied. When Portland cement and sand are used it is very essential that the sand should be absolutely free from any organic materials which have a tendency to discolor. It is also of vast importance that the ingredients be mixed very accurately and carefully and that a sufficient amount be mixed at one time to cover certain areas exposed to the same lights and shadows.

For example, the work should not be left in an uncompleted condition half way between windows or half way down the side walls, for just as certain as this is done, there will be a streak showing where the later work was started. If it is necessary to do a certain given area at two operations, care should be used to get the materials properly blended and the new stucco floated or trowelled to correspond exactly to that already done. By using a little care on details of this kind the ultimate results will be much more satisfactory.

Portland cement and sand as a stucco mixture has been used with fair success where work has been carefully supervised, but there has been such a lack of proper attention to the mixing and application that there have been some very bad failures. The use of asbestos rock and fiber to take the place of sand is meeting with considerable success. The asbestos fibers have a tendency to hold the water which is used to mix the concrete mass, longer, thus giving the Portland cement ample opportunity to become properly set and in this way stucco mixtures are possible that are more uniform in color and less liable to crack as the fiber also furnishes additional bond.

There is one point which is frequently lost sight of, that is it is possible to manufacture or make concrete slabs that are free from cracks and that can be exposed to the elements for an indefinite period without discoloration. Therefore, should cracks develop in a well constructed stucco work it can be invariably traced to setting of the building or the shrinking of the frame. By insisting upon thicker stucco walls the liability of the stucco cracking is reduced to a minimum.

The price of lumber is readily advancing and the desire for fireproof exteriors, especially in the suburban districts as well as artistic effects that may be obtained from stucco are creating a universal demand for this type of construction and while the initial cost may be sligthly more it is such a small part of the total outlay and such an important part of the structure that the best is the cheapest in the end.

ST. LOUIS CEMENT MILL.

The St. Louis Portland Cement Company, St. Louis, Mo., employ a Model 100 Marion Steam Shovel in their quarry.

Inspection of Surface Finishes for Concrete Work

By Jerome Coehran, C. E.

Continued from page 77.

2. Introduction of Various Ingredients Into Mortar or Concrete.

Different Sized and Colored Aggregates.—If a permanent colored concrete surface be desired, it may be obtained by properly finishing a surface faced with a mixture composed of Portland cement and an aggregate of the proper size and color. By varying the kind, size and proportions of the aggregates, surface finishes of practically any desired color and texture can be obtained, the possibilities being limited only by the number of different aggregates available and the combinations of same. The surface must be scrubbed, sand blasted or otherwise treated, so as to expose these aggregates. Pebbles, burnt clay, or broken brick, white marble chips, blue trap rock, other colored marbles, etc., together with the gray matrix of the cement mortar, can be combined to give almost any desired combination of colors and surface effects, thus giving an animated texture to the otherwise leaden and lifeless material. A great variety of finishes may be produced by using glistening marble, gray trap rock, red and black granite and limestone screenings, black and white marble chips, different-colored pebbles, yellow sand, brick dust, etc. Obviously, if special effects are desired with this course of treatment, the concrete must be deposited with exceptional care.

Use of White Cement and Aggregates.—A white concrete surface may be obtained by mixing 1 part white Portland cement with 2 or 3 parts coarse white sand or marble screenings, and applying the mixture as a finishing coat or mortar facing. After the coating or mortar facing has set hard, it should be washed off with dilute sulphuric acid, 1 part acid to 5 parts water. The acid solution should be applied by painting on with a brush two or three successive coats and the surface then washed with plenty of clean water. White pebbles of various sizes can also be employed and the aggregate may be anything from the size of coarse sand to that of pieces an inch or more in diameter. White sand or marble dust used in making concrete gives the finished work a lighter color than is obtained by using ordinary sand.

Coloring Matter.—Coloring matter mixed in mortar is sometimes used to give a uniform color to concrete surfaces, especially where a permanent sur-colored surface is not desired. It is much easier to produce color effects by employment of stucco than by endeavoring to produce colored cement or some coloring compound in the mortar of the mass concrete work. If used in the entire body there is a waste of material in that which is not exposed, and it is difficult to get uniformity by any other means, unless it is a case where plastering is permissible. Either for facing mortar or mass work, however, coloring materials have been successfully employed, the dry mineral color being added to the Portland cement before mixing. A little lamp black can be used to advantage in ordinary concrete to relieve the dirty color of the concrete by giving a much more pleasing and uniform color than can ever be obtained with straight cement.

Selection of Coloring Matter.—Don't use artificial coloring matter containing oils, grease or acids. Coloring matter containing acids will attack the akaline substances in cement and destroy it. Only those coloring materials should be employed which consist of the oxides of the various elements, since the salts are liable to disintegrate. Care must, therefore, be taken in the selection of the coloring matter. The quantity and quality of the coloring matter must be such as not to impair the strength of the concrete. Most coloring substances are bleached by the cement and are of short life. Lamp black has been most commonly employed, giving different shades of gray according to the amount used. Bright colors are difficult to obtain and would not be in keeping with a masonry structure, except in architecture.

Samples of Colored Mortar.—Sample specimens containing different proportions of the specified coloring matter and of Portland cement should be made and allowed to become quite dry before being submitted to the engineer for approval. It will be the duty of the inspector to see that these samples are properly prepared. In any large work where the use of coloring matter is desirable and there is not time to properly prepare samples or to institute thorough tests, the advice of a cement chemist should be sought. Samples of colored mortar will go a long ways by indicating just what colors may be used without detriment to the work. It is cheaper to prepare samples of colored facing mortar beforehand than to cut out work already done.

Proportioning Pigments.—The following proportions are suggested, the amounts named being added to a bag of Portland cement, containing about 95 lbs:

Black, 2 lbs. Excelsior carbon black.
Blue or green, 5 to 6 lbs. ultramarine.
Brown, 6 lbs. roasted iron oxide.
Gray, 1 lb. of lamb black.
Red, 6 to 10 lbs. raw iron oxide.
Yellow or buff, 6 to 10 lbs. yellow ochre.

It will be seen that any desired color may be obtained by varying the proportion of mineral coloring matter. The dry mineral colors, mixed in proportions of two to ten per cent of the cement, give shades approaching the color used. The addition of mineral colors to cement causes a loss of strength except ultramarine, but this is generally not very important, since the color is used only in mortar facing, or surface coat. Ultramarine seems to add somewhat to the strength of cement. It is unwise to use more lamp-black than mentioned above, and the writer would suggest that just about half of the amount be used. Don't use artificial coloring matter in excessive quantities.

Mixing Colored Facing Mortar.—Variations in character of cement and sand will affect the result obtained in using coloring matter. Sand for the colored facing mortar must be perfectly dry and the cement, sand and coloring matter should be mixed dry before the water is added. It is sometimes customary to mix the coloring matter with the cement dry, before any sand or water are added. This mixture should be thorough, so that the mixture is uniform in color. In mixing the ingredients, the greatest care and exactitude are essential. If improperly mixed, the surfaces are apt to be spotty. After this mixing the combination is treated in the same way as clear cement. The coloring of the mixture when freshly made must be deeper than that actually required in

the finished surface, as the colors will bleach considerably on drying out. It is, therefore, advisable to experiment a little to find how much color is needed to give the desired shade. This may be done by preparing sample specimens containing different proportions of the coloring matter and of Portland cement and allowing them to be come quite dry before observation.

Directions for using coloring matter may generally be had of the makers. The inspector must carefully follow these printed directions.

3. Removal of Surface in Various Ways.

If made right, the concrete surface will have a skin of neat cement. It is generally desirable for appearance sake to remove this, and there are several ways to do it, depending upon the length of time that the concrete has set, before it can be made accessible, for treatment. The time that elapses from the placing of the concrete until the surface can be exposed depends upon the kind of concrete and the nature of the part of the structure in question. If the concrete surface is hard, more vigorous work is required to make it smooth and to take off the skin of cement.

Scrubbed or Brushed Finish.

A scrubbed or brushed finish is obtained by removing with a brush the surface film of cement which forms over the aggregate, thus exposing the aggregate to view. This method of treatment gives a rough texture to the surface, and by the use of selected aggregate for the concrete, any desired effect can be obtained. The roughness of the surface breaks up the light, the color of the aggregate adds variety and life, and the result is a more artistic surface.

Preparation of Forms.—For scrubbed or brushed surfaces, all that is required of the forms is that the face lagging be kept true to surface and that the joints be tight. When it is proposed to scrub or brush the surface of the concrete before it is more than twenty-four hours old, the forms must be constructed with the idea of being removed without damage to the rest of the structure. For surfaces too large to concrete in one day, the forms should be so constructed as to permit of the removal of sections of the face form. In other words, forms should be built in sections and so arranged that each section can be taken down at the proper time, to give access to the face of the concrete, without taking away the standards which provide strength for the forms as a whole.

Placing of Concrete.—Either the small aggregate, viz., sand, or the larger aggregates, together with the smaller aggregates, viz., the sand and stone, may be exposed by scrubbing or brushing. There is a slight difference in the placing of the concrete, depending upon whether the large or small aggregates are to be exposed. Specifications should be explicit as to whether the smaller or large aggregates are to be exposed by scrubbing or brushing. If they are not, the inspector should learn from the engineer which aggregates are to be exposed and should see that the contractor clearly understands the requirements. In case the smaller aggregates are to be exposed, the concrete should be carefully spaded between the concrete and the surface in the form, as this brings to the surface finish particles of sand and the cement itself. In case the large aggregates are to be exposed, no spading should be done, but all the tamping of the concrete should be done in the middle of the wall, as this causes the pushing of the larger aggregates against the surface of the form.

Great care must be taken in successive casting to prevent marks showing (after scrubbing or brushing) where the new and old work join.

Removal of Forms.—For scrubbed or brushed surfaces, the forms must be removed from the work as soon as possible, and the concrete surface brushed while still green. Forms should be removed within twenty-four hours of the placing of the concrete, during warm, dry weather; otherwise, to remain as much longer as conditions require, which will be determined according to the temperature of the weather, setting quality of the cement, type of work, mixture used, etc. Heavy walls in dry concrete could probably have the forms removed in twelve hours or so after concrete is placed, and the surface could be thus treated. The forms, however, should not be removed so soon on a high section of wall.

Treatment by Scrubbing or Brushing.—The process consists in scrubbing or brushing the concrete surfaces with ordinary fibre (or wire) brushes and water until all of the surface cement has been washed off, leaving the gravel or broken stones exposed and in good relief. If necessary, a small amount of muriatic acid should be added to the water. The concrete surface should be scrubbed until the surface film is removed and the aggregate is exposed to a uniform degree, and then rinsed off with water. Water should be freely used from a hose and the amount of force exerted in the scrubbing or brushing will give shallow or deep cutting effects as desired. When the forms are removed at the right time, three or four passages of an ordinary scrubbing brush with plenty of water is all that is required. Cement particles removed by the brush must be thoroughly flushed off the surface by clean water, else they will adhere in patches and form rough blotches.

For scrubbing the surface ordinary scrubbing brushes with stiff palmetto or other fibre bristles with a light stream of water from a hose or can will generally be sufficient if the concrete has not set too hard. If set is harder, wire brushes followed by fibre brushes and rinsing may be used. Fine and coarse brushes should be used. A cheap and effective brush can be made by clamping or fastening together a sufficient number of sheets of wire cloth in such a manner as to make a brush about four inches wide. Such a brush will generally be found more effective than the ordinary wire brush for brushing green concrete surfaces.

Precautions.—Care must be taken that the pebbles are not dislodged. The time for scrubbing is when the concrete is still green, but if the concrete is too soft to permit scrubbing, the work must be delayed a sufficient length of time. It is not possible to state how old the work should be before removing the forms and scrubbing the surface. This will depend upon a number of conditions, the character of the work, cement and aggregate used, consistency of the mixture, and very much upon the weather conditions. Care must be taken that the scrubbing is not done too soon, as little particles of aggregate will be removed, resulting in a pitted, unsightly surface. The scrubbing or brushing should be started just as soon as it is possible to do so without removing particles of aggregate. When this can be done can only be determined by experimenting with the particular surface. The hose should be used without a nozzle, as the pressure may gouge out stones. Water may also be applied with buckets. Some care must be exercised to make the scrubbing uniform, as too much or too little pressure on the brush will make considerable difference in the appearance of the finished surface. The scrubbers soon get accustomed to this, however, and learn to vary the pressure with the state of hardness of the surface. In scrubbing concrete surfaces, care must

always be taken to avoid roughening or blunting corners of the work, and to maintain all edges sharp.

Sand Blasting.—If, for any reason, a portion of the face form cannot be or fails to be removed before the concrete has become too hard for removing the surface film by scrubbing, the hard face may be treated by sand-blasting or tool-dressing, to a texture matching the scrubbed portion.

Patching Defective Work.—If any void spaces appear, or if spalls are broken off, the defects should be patched with similar mix immediately after the scrubbing, using the hand or a wooden float—not a steel trowel—for applying and smoothing the patches. After they are sufficiently set (say within from 5 to 24 hours), all patches should be scrubbed to the same texture as the general surface and be rinsed clean and kept moist for several days.

Pebble-Dash Facing.—The concrete should be composed of gravel and rounded stone not exceeding 1 in. in its smallest diameter. When the forms are removed the cement and sand must be brushed from around the face of the gravel with fibre or steel brushes, as described above, leaving approximately half of the gravel exposed. Brushing should commence within twenty-four hours after the concete has set.

Instead of exposing the pebbles in the aggregate proper, the following method of artificially exposing aggregate may be employed: After erecting the forms of rough boards in the usual manner, in courses of three feet or less, plaster inside of these forms with wet clay, and to this wet clay apply different colored pebbles in sizes of 1 inch down to those that will be retained on a ¼-in. screen. The pebbles will thus stick to the clay. Concrete may now be poured in and the forms removed in the usual time. The clay is to be washed off with a hose and the concrete surface scrubbed slightly with a brush. Care must be taken that the pebbles are not dislodged. Any colored pebbles desired may be used in this way and the pebbles will give some very delightful and varied effects. Other methods of securing pebble-dash finish will be discussed later.

Cut-Stone Facing.—A method similar to the one used in obtaining a "Pebble-dash" may be employed in giving to concrete the appearance of cut stone. In this case, crushed rock is substituted for the gravel, the character of the rock depending upon the color and texture desired in the finish. After the removal of the forms the cement and sand must be brushed from around the face of the stone next the face exposed to view, followed by clean water.

(To Be Continued)

CEMENT STUCCO.

As to methods in doing stucco work, I am always more interested in reading about it than in giving information, but here is my method and I have not had a poor job yet. This is my way on an old building for two coat work: First, see that everything is well nailed up tight, then cover the entire building with single ply tar paper. Take steel furring strips and nail 12″ o. c. and drive staples every 6″ up and down (take whatever size the job calls for, usually ¼″); then run the expanded metal lath around the job and also fasten with staples right over the furring. This must also be well nailed, also any sags that may form in between the furring. The work is then ready for the first coat of plaster. I use this quite coarse I put my sand through a ¼-in. screen *run flat,* and take this sand and mix 3 to 1 with not more than 10% of hydrated lime. (I very seldom bother about hair). I want the first coat pushed clear through the lath and tight up to the tar paper and enough more to cover all the lath, then it should be scratched well—real rough. I like to have this well set up before I put on the next coat, writes Lewis T. Howe, North Weymouth, Mass., in Concrete-Cement Age.

For the second coat I use a ⅛-in. screen placed on an incline of about 45° and screen my sand through this and mix this 2 to 1 with 5% hydrated lime added, and before plastering this on, I have my first coat well sprayed with water and kept well soaked, ahead of the men. This coat is generally finished with a wood float and if proper care is used in putting it on, there is not much danger that it will crack. As many more coats can be put on as desired, but for a cheap job,

Cement Stucco Residence for Mr. A. Salisbury, San Antonio, Texas. Architect, Emmet T. Jackson, San Antonio. This house was constructed with a wood frame and lathed on the exterior and interior with 24-gauge Kno-Burn metal lath, then plastered with Portland cement plaster. Northwestern Expanded Metal Co., Chicago, furnished the metal lath.

these two coats will give good satisfaction. The work looks fine after floating and right here is where most people's trouble starts. Most men call the job finished, but it isn't. If the weather is hot or dry, or hot winds are blowing, it should be taken care of. Just as soon as it is safe to do so, I wet it with a very fine spray and keep it damp for several days, and if possible, hang canvas up to keep the sun away from it and a little extra care in this way pays well. As to the lime, I find it is an advantage to soak it at least 24 hours before using, as it gives better results. It is not much trouble to find out when you have the right proportion of putty, which I stir in the water that I wet the cement and sand with, and I also want all this mortar well mixed.

I was in Medbury, N. H., this summer to put in some cow mangers and stalls for about 50 cows, and the farmer had his barn stuccoed all over this summer. He asked me what was wrong with the job, as he was dissatisfied with it. He said he paid his men 60c per hour and board, and they were considered good men. This was a two-coat job, and I really think there was enough material used in the job to have turned out a fine piece of work, but I think they used too much lime. They used about 25%. This barn was boarded up and down, and on the face of these old boards they put the ordinary plasterers' lath, which is 4′ long, 1½″ wide and ¼″ thick. These lath they nailed all around the building about 16″ o. c. (no paper back of lath); then they nailed expanded metal lath up and down the building and put on the two coats of stucco. They followed up very close with the second coat, so as to avoid letting it dry out, and for that reason I should judge that the first coat was scarcely hard enough to cover yet, and this work was never sprayed nor shaded, and was put on right in the middle of summer. This work cracked so badly that a knife blade can be run into every crack and most of the splices of the metal can be traced by the cracks. Every batch of mortar that was mixed can be distinguished.

Some people think that there is nothing to it—just to put stucco on a building, but I find it is necessary to put quite a few brains in the mixture if a good job is wanted. I find that many masons want to be too free with the lime, and I forgot to say that in this job it looks as though the hair were thrown in free, as in places it sticks out like hair on a dog.

Don't use too much lime. Use plenty of cement. Use coarse sand in first coat. Push well through the lath. Keep work well sprayed with water until hard. Spray well before putting on second coat, also any other coats that may be applied. I don't approve of two-coat work, but on cheap jobs, people will have it. I think it is best to have no less than three coats.

Another very important matter is the measuring. I find many people use the shovel to measure with. This is all guess work, as no two men will measure alike. A bottomless box to hold just the amount of what sand it is expected to use in each batch with a sack of cement is a handy thing. In measuring lime I generally find a pail of about the right size. Now another very important part of stucco work is to have help enough on the job so that when stopping or starting the work, there are no places to show, but always finish to a corner or up to some window or door frame, as it is very hard to make a neat appearing "splice" in between night and morning work.

Cement Stucco House on the Sea Shore at Cohasset, Mass. L. D. Wilcutt, Estate, owner. Joseph N. Wilcutt, architect. This house was built of frame construction without any sheathing. No. 24 gauge Kno-Burn galvanized lath was applied directly to the studding on the exterior and then plastered with a heavy coat of Portland cement plaster. Metal lath manufactured by the Northwestern Expanded Metal Co., Chicago.

CEMENT MILL CONSTRUCTION WILL BEGIN SOON AT SAN FERNANDO.

L. Overbaugh and A. L. Dennis, of the National White Cement Co., of San Fernando, Calif., have announced that work on the plant of the company will begin within about thirty days.

Among the first work of the company will be the building of a road from the plant up to the deposits of the natural cement at the mountains east of town.

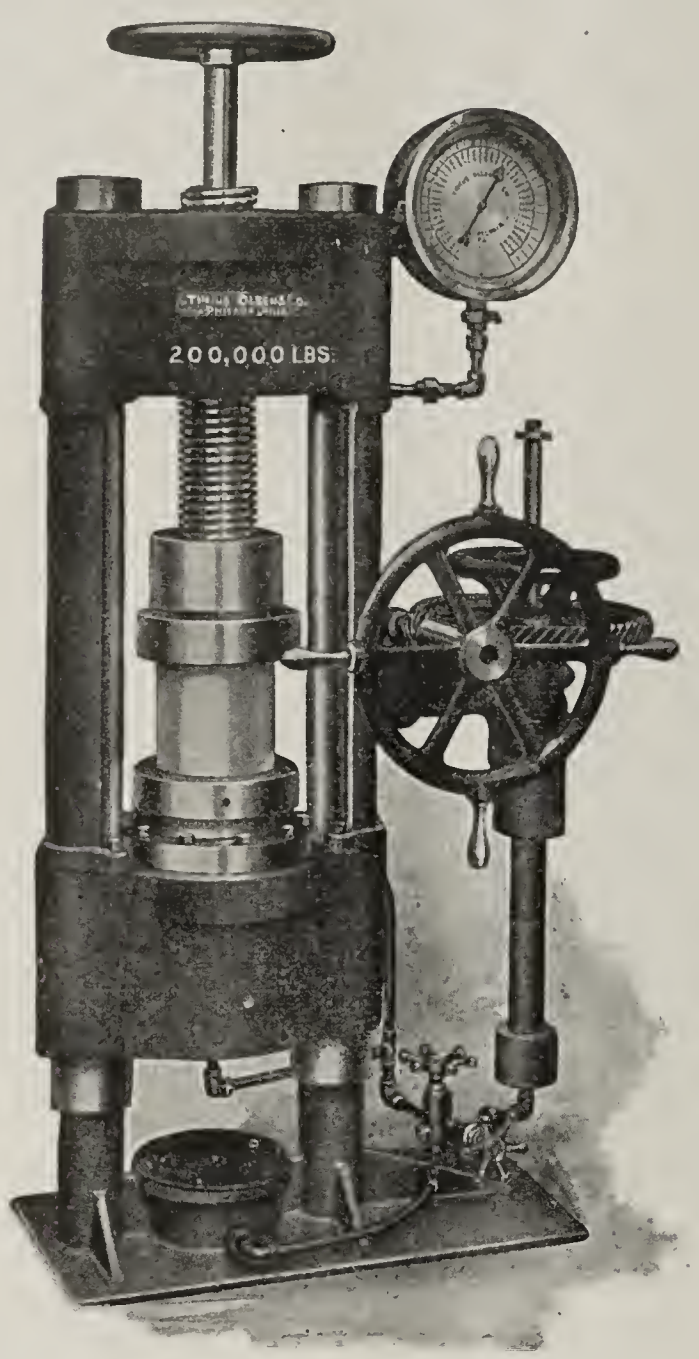
Mr. Overbaugh and Mr. Dennis are also negotiating for a site for the plant to manufacture pressed brick and roofing tile, which will be run in conjunction with the cement mill, using the products of the latter to make the former articles.

OLSEN'S NEW PATENTED COMPRESSION TESTING MACHINE

100,000 lbs. and 200,000 lbs. capacity.

This illustration is of the very latest type of hydraulic compression testing machine, designed to meet the demand for a "field" machine of sufficient size and low cost so as to make the compression test practicable and thereby further the use of the compression test.

Most cement and concrete is subjected primarily to compression when in service, therefore it is only logical that such material should be tested primarily in compression. It is also essential to test samples of such size that the results will be comparable to those of actual practice and thus as much as possible elim-



COMPRESSION TESTING MACHINE.

inate the personal equation so evidently manifest in the making of small tension briquettes.

We recommend for this class of test, says the manufacturer of this machine, either a 6 in. cube or an 8 in. by 16 in. deep cylinder and for tests up to and including the size specimen recommended a 200,000 lbs. capacity all the essential points for making a quick accurate testing machine. This machine was designed to cover compression test as follows:

1. Quick adjustment by upper hand wheel.
2. Ball socket adjustment in upper head.
3. Olsen's new patent packing in the cylinder thus greatly increasing the accuracy of the gauge reading.
4. Single stroke screw pump by means of which with one stroke any cement or concrete specimen may be broken with an even application of the load and which can easily be applied to the full capacity of the machine. This obviates the undesirable and deteriorating results due to pulsations of a reciprocating plunger pump.
5. Fast and slow motion of pump provided either by action on the screw direct or through gearing as shown.
6. Valve system provided for drawing oil from the reservoir in the base and holding the pressure in the cylinder when refilling the pump where considerable plunger motion is required for special tests.
7. Very compact and self contained making an ideal machine for transportation.

Place the specimen on the table, have the pump filled with screw all the way out. Then take up the slack with upper hand wheel and apply pressure by the screw pump until the specimen breaks, noting the breaking load on the gauge.

The plug in the reservoir cover should be removed when using the machine to admit air to the reservoir.

Light machine oil should be used and to remove any air from the cylinder that may pass into same during transportation, merely screw down the upper screw until it touches the plunger, remove plug in the upper part of the cylinder and force the oil from the pump into the cylinder until it flows from the small hole, then return the plug and the cylinder will be entirely free from air. The machine is used by the Westinghouse, Church, Kerr & Co., New York; Modjeska and Angier, Chicago, Ill.; U. S. Reclamation Service, Boise, Idaho; U. S. Reclamation Service, Engle, New Mexico; Northern Pacific Railroad Co.; St. Paul,Minn.; Pacific Portland Cement Co., San Francisco, Ca.; New York State Testing Laboratory, Albany, N. Y.

CEMENT COMPANY PROSPERING.

"Undoubtedly, the past year has been the most prosperous in the history of the cement industry," said N. S. Potter, Jr., vice-president and general manager of the Michigan Portland Cement Company of Chelsea, a few days ago. "Our own plant has been operated to its utmost capacity every minute since the season opened May 1. Prices are now 25 cents per barrel higher than at the same time a year ago, and it has been almost impossible to keep up with our orders. We expect to keep the plant in full operation until about February 1, when the cold weather will probably force us to close down until spring, giving us an opportunity to make repairs and put everything in readiness for next season."

The plant of the Michigan Portland Cement Company is located at Four Mile Lake, about three miles east of Chelsea, on the main line of the Michigan Central Railroad. About 100 men are carried on the pay roll, and the average daily output is seven to eight carloads. Some of the larger and more important orders filled during the past summer were: 25,000 barrels for the new Michigan Central depot in Detroit, 20,000 barrels for the big power dam on the AuSable river and big shipments used in the construction of the Leonard street bridge in Grand Rapids.

The process of cement manufacture is very interesting, and visitors to the big plant are always welcome and are accorded every courtesy. Recently, the general offices of the company were moved from Four Mile Lake to Chelsea, occupying its own building, erected and formerly occupied by the defunct Chelsea Savings Bank. Here the company maintains a very complete reference library on cement construction, and has a number of interesting booklets on the use of cement on the farm, describing the construction of farm tanks, foundation and wire walls and kindred subjects of interest to progressive farmers.

SOLVING LOS ANGELES' GREATEST WATERPROOFING PROBLEM.

In constructing the new Times building in Los Angeles, the architects were called upon to solve one of the most difficult waterproofing problems that has ever confronted the profession. The location of this building is the corner of First and Broadway, at the foot of what is known as the Broadway or Courthouse Hill. All the buildings constructed on this hill, including the Los Angeles County Courthouse, Hall of Records, Times building, etc., have at one time or another been confronted with an extremely difficult waterproofing problem, caused by a very live, underground spring of water which has always existed in this hill.

Before the old Times building was dynamited by the McNamara brothers and associates, the old basement was constantly being flooded by water leaking through the brick and concrete walls and basement floor. It seems that they had a sump hole and pump which worked several hours every day pumping out this water summer and winter. Of course in the winter time the additional drain water from the rain added a further pressure to the regular underground spring pressure.

To create an extra sub-basement in the new building of the Times it was necessary to go down over twice as far as the old basement floor level for the new sub-basement floor level.

On the north rear, and east and west sides of the basement there now exists concrete walls of 30 feet to 40 feet in height; against this wall there exists a top stratum of soil about 10 or 12 feet deep, a gravel stratum below that of 12 or 15 feet in thickness, and blue clay of impermeable consistency below the gravel stratum.

The middle stratum of gravel is always heavily saturated with the water from the underground springs. When this gravel stratum is stopped by the basement walls of the Times building, the water pressure therefrom saturates the soils above and below the gravel to such an extent that a thin sheet of water forms between soils and the outer face of the walls to their full height. The saturated soil, pressing against this thin sheet of water, which in turn presses against the concrete wall, causes a direct hydrostatic pressure for the full depth or height of the wall. The water even goes so far as to force its way down below the walls and under the floor of the sub-basement. This was shown by the fact that water kept coming constantly through the floor of the excavation before the foundation walls and basement floor were completed.

Ceresit, one of the most widely known paste waterproofing compounds, was used through the foundation, basement walls and sub-basement floor of this building. The proportion used was one-half pound of Ceresit per cubic foot of concrete in the sub-basement floor and in the lower half of the basement walls. In the upper half of the basement walls three-eighth pound of Ceresit per cubic foot or about 11 pounds per cubic yard was used in the entire concrete mass.

Ceresit was dissolved in the water which went into the concrete mixer, and as the water carried the compound automatically to all parts of the concrete aggregate, a thorough and scientifically accurate placing of the waterproofing occurred through the entire concrete mass.

Very thorough test reports by Robt. W. Hunt, testing engineer of Chicago and local testing engineers, showed that absolutely no action occurred against the tensile or compressive strength of the concrete. The walls and floors inside of the building indicate in a very practical way that the basement is as dry as a bone, except at one point where a concrete construction with very coarse rock pockets against plumbing pipes running through the walls has allowed water to come in along pipes and faulty construction in concrete. At all other points where the water pressure is just as severe as at this point the inner surfaces of the walls and floors indicate no moisture whatever.

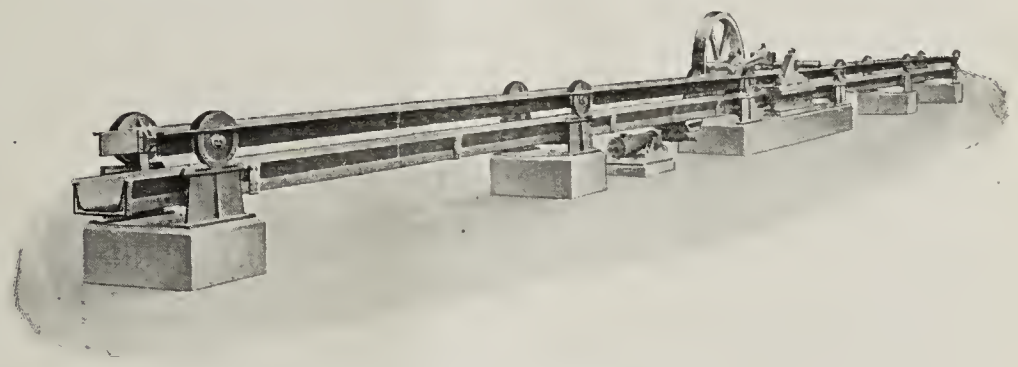
Experts declare this to have been the most severe waterproofing problem that ever existed in Los Angeles. The altogether satisfactory handling of it has proved especially interesting to those architects and engineers who were conversant with the conditions described.

THE TORPEDO CONVEYOR.

The Torpedo Conveyor, for which the exclusive manufacturing rights have just been obtained by Chalmers & Williams, Chicago Heights, was introduced by Amme, Geisecke & Konegan, Brunswick, Germany, two years ago.

Since its appearance on the market it has met with great success in plants where it is necessary to convey sharp rocks, ores, chemicals or any other material which has a destructive effect upon a belt conveyor. Material is conveyed in a steel trough which will outwear a large number of belts, and is the only part which is ever necessary to replace.

The conveyor, as illustrated in the above cut, consists of a long trough of sheet steel made in sections which is supported by a number of small carriages running to and fro on tracks. A motion backwards and forwards is imparted to the whole trough by means of a crank gear and crank shaft driven either by a belt or by a direct connected motor. On the forward stroke air is compressed through a piston in



TORPEDO CONVEYOR.

a cylinder which is shown under the conveyor. At the point farthest forward this compressed air gives to the trough a quick reverse motion which suddenly throws it back to the starting point, leaving all of the material in the trough at the point farthest forward, to which it had been conveyed on the forward stroke. This motion repeated approximately fifty times a minute forms the means of transmission.

The driving mechanism may be placed at any point along the conveyor or at either end, and is varied in size and power according to the length of the conveyor. It is also to be especially noted that the conveyor can be extended in either direction at any time.

The large list of users published shows the different uses to which the Torpedo Conveyor has been applied by a large number of industries in Europe, among which may be mentioned coal, clinker, salt, crushed stone, ore, lime, salt petre, phosphates, slag, carbide, etc., etc.

The New Cement Mill and Lime Hydrating Plant at Union Bridge, Maryland

Large Mills Using Individual Motors For The Operating Machinery

A plant for the manufacture of Portland cement and hydrated lime has recently been built and put into operation by the Tidewater Portland Cement Company of New York. It is located at Union Bridge, Md., a point on the Western Maryland Railroad about 40 miles from Baltimore. The company has acquired about 240 acres on the outskirts of the town where the plant is laid out as is shown in the accompanying drawing. Construction was started on the lime plant October 1, 1909, and on the cement plant May 1, 1910, while they were put into operation on August 15, 1911.

General Features.—The buildings, in most part, are of the mill type of construction, with structural steel framework and plastered expanded metal walls. In addition to the buildings devoted exclusively to the manufacture of the products, there is also a power house, a machine shop, a store room, an office building and a laboratory. The ultimate capacity of the cement plant along present lines will be 3,000 barrels per day, while the present output is about 1,500. Only partial installations have been made of such units as kilns, driers, etc., but all foundations, conveying machinery and power house equipment provide for the total capacity of plant.

Raw Material.—The quarries which are the source of the raw material are located on the property a short distance from the site of the mill. Unusual geological conditions simplify the process of securing the raw material. The limestone and shale outcrop together, and the dip of the strata is such as to give easy access to both. The limestone is of very good quality as is shown by the analysis made of it. The deposit utilized for the manufacture of hydrated lime lies at the west end of the quarry, and is handled independently of the material used for cement. The limestone is quarried with the aid of air drills and dynamite. The air compressor supplying the drills is located in a building near the quarry. The blast is broken up by hand and loaded into side dumping cars built of structural material, with a capacity of eight tons. These cars are handled by an ordinary standard gauge yard locomotive. A ladder track connects the quarry with the track system about the plant, and from this are laid spur tracks, enabling the loading of material at various points in the quarry. The raw material for the lime plant is handled by gravity on a narrow gauge, 24-in. track. The lime cars have a capacity of 3½ tons, and are similar in design to those used for the cement material. There are independent track scales for weighing all raw material before it enters either the lime or the cement plants.

The Hydrated Lime Plant.

Handling Material.—The raw lime travels from the quarry to the foot of an incline entering the lime kiln house by gravity. This incline is of structural steel and extends to the charging floor of the kiln house. It carries a so-called idler with an automatic coupling device, which engages with the coupling of the car from the quarry. This idler is connected by a cable with an electrically operated hoist which hauls the loaded cars to the charging position. The cars are then dumped directly into the kilns and as emptied are allowed to run free part way down the incline, thereby acquiring the necessary momentum to reach the quarry. There are five kilns 12 ft. in diameter and 48 ft. high, with shells of steel plate, lined with high silica brick. The coal enters the building by a bucket conveyor discharging into a storage bin. From there it is taken by hand to the two furnaces of each kiln. The coal used is soft bituminous, commonly called slack, and it is stated that 1 lb. of coal is required for 4 lbs. of lime produced. The firing floor is located about 12 ft. above the lower level, and the charging floor is 48 ft. above the former.

Hydrater.—The product of the kiln, lump lime so-called, is drawn through a swinging gate at the bottom into wheelbarrows, weighed on platform scales, and dumped on to the floor of the kiln house. It is then shoveled by hand into the hopper of a Sturtevant pot crusher, which grinds it to a degree of fineness not exceeding ¾ in. The hopper feeds directly into a screw conveyor connecting with a bucket elevator, which carries the product to a storage bin located above the hydrater. This method of transporting material, in various combinations, is used throughout the plant. The material passes directly from the storage bin to a Kritzer hydrater, manufactured by the Kritzer Co., Chicago. This comprises six metal cylinders, one above the other, and connected at alternate ends to permit of transit of material. The transit is effected by means of shafts passing through the cylinders, equipped with paddles having a clearance of 1 in. from the inside of the shell. The shafts in alternate cylinders rotate in opposite directions. The water is supplied through a stack at the top of the hydrater, in which is placed a deflecting cone, for the purpose of spreading the water and thereby reducing the dust.

Fuller Mills.—The product of the hydrater passes by a screw and bucket conveyor to a bin over the Fuller mill or grinder. This is a centrifugally driven mill in which the grinding is accomplished ordinarily by four steel balls weighing 260 lbs. each which revolve against a horizontal plate and a steel die in a casing. In grinding the hydrated lime, however, only two balls are employed. The diameter of this die is 42 in. The balls are moved by pushers affixed to the vertical spindle which can be rotated in either direction. The material is fed in at the center of the mill and forced by the centrifugal action between the grinding balls and the steel die. The horizontal plate is perforated, enabling the passage of ground material to a conveyor and all the other machinery in the lime plant is driven by means of a line shaft connected to a 100-hp horizontal single-cylinder, non-condensing engine. It is the only steam-driven mill in the plant, and it is stated that motors will soon be installed in place of the present equipment. The product of the Fuller mill is marketable hydrated lime, and it passes from the Fuller mill to a storage bin by means of a typical screw and bucket conveyor. It should be noted that the transit of the lump lime from the kiln to the finished product is continuous. In both the lime and cement mills it is stated that storage bins are more

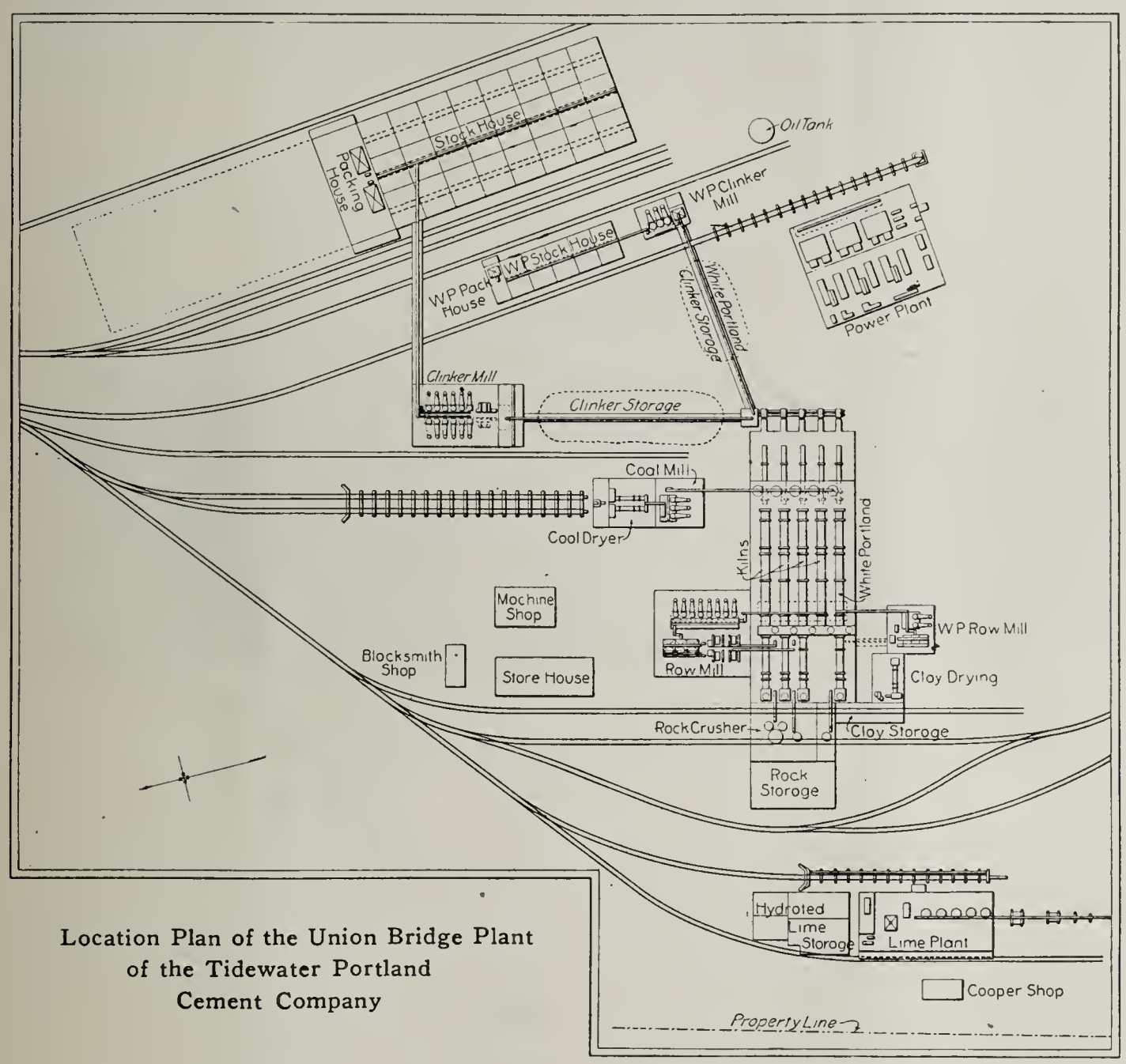
of a provision against possible breakdown in the subsequent steps of the process than as a necessity in the process itself. Below the storage bin is a Bates automatic valve bag packing machine which weighs the contents of each bag and seals the same, thereby securing uniformity of units. The bags are piled by hand in a store room, which is the only wooden building in the plant and has a storage capacity of 2,000 tons. The average daily output of the kilns is about 55 tons, and of the plant is said to be 20 per cent higher on account of the water added in the hydrating process.

The Portland Cement Plant.

Handling Material.—In the cement plant after the cars of raw material have passed the scale house they are dropped by gravity to the foot of an incline entering the cement mill. This building has at either end an incline equipped with a Bartlett and Snow motor-driven endless chain hoist. On this chain at intervals are dogs which engage with an I-beam on the bottom of the car thereby pulling the car up the incline. When the car reaches the charging floor level the dog automatically releases and within the building the car is handled independently. In a precisely similar fashion the car is taken down the incline at the other end of the building, and as the two inclines are directly connected by a rope drive, and are driven by the same 27-h. p. motor, an economy of power results, the empty car assisting to pull up the full one. In this building and during subsequent steps in the process the shale and limestone are treated separately and in precisely the same fashion except as noted. Entering the building in the direction of the passage of raw material the bins for storage are at the left and the progressive transia of the material is to the right. The general arrangement in this building is shown on accompanying drawing.

The loaded cars are dumped with the aid of an electrically operated block, and one man handles the cars while they are in the building. The raw material is dumped into a wooden chute lined with T rails and passes from this to a No. 9 Gates, manufactured by Allis, Chalmers Co. gyratory crusher driven by a 150 h. p. motor. In the case of the shale a No. 6 gyratory driven by a 50 h. p. motor is used. From the No. 9 crusher the limestone passes to two No. 6 belt-connected gyratory crushers, and from there it passes to an apron conveyor. The apron conveyor for the limestone is 30 in. wide and for the shale is 24 in. From the conveyor it passes to a bucket elevator which dumps it into a hopper with two chutes. One of these chutes conducts to the drier bins, while the other feeds into a bucket elevator connected with a belt conveyor which passes overhead to the storage bins. There is also a belt conveyor passing underneath from the storage bins to the bucket elevator receiving the material from the apron conveyor previously mentioned. This enables direct drawing from storage. It should be noted that this permits of a complete cycle of operation, as control of the drive enables the conveyors to be operated in either direction. In this building is installed a track for the handling of white clay for use in making white Portland cement. This feature of the industry has not yet been started.

Drier and Ball Mills.—The raw material next passes into the driers. These are cylinders 6 ft. in diameter and 50 ft. long, built of boiler plate with channels riveted on the inside. They are supported on concrete pedestals and are located directly back of the



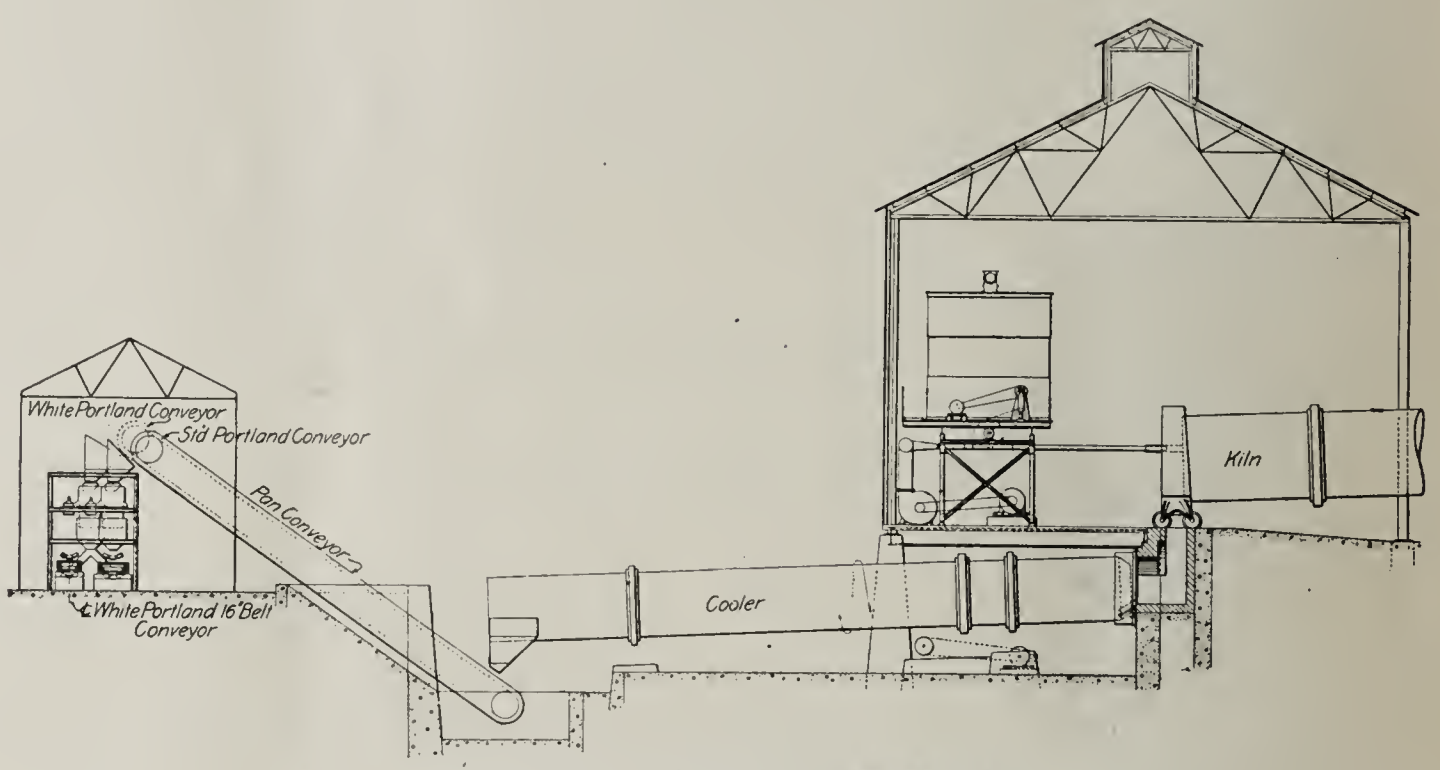
Location Plan of the Union Bridge Plant of the Tidewater Portland Cement Company

cement kilns, and derive their heat from the waste heat of the kilns. A stack 100 ft. high is placed at the upper end of the driers. The passage of the charge through them is entirely due to their inclination. From the driers it passes to a conveyor which carries it into the bins over the ball mills. This conveyor differs from those commonly used about the plant in having pivoted buckets. The ball mills are No. 8 Krupp and comprise essentially an outer drum or casing, and an inner drum rotating about a horizontal axis. The inner drum is made up of two circular wrought iron side plates, one secured to a blank and the other to a spider hub and both keyed to the shaft. Between them and bolted to them are tough cast steel plates arranged so as to form steps and perforated to permit of the passage of ground material through them. The material is fed into the mill at the center through the spider nave. The inner drum contains steel balls graded in size from 4 in. diameter down, and the grinding is accomplished by the percussions of these balls against the steel plates. These mills are located on concrete piers 12 ft. high and are driven by individual 50 h. p. motors. From the ball mills the material passes by screw and bucket conveyors into regulating or mixing bins equipped with a mechanical weighing device. It is to be noted that up to this point the limestone and shale have been kept separate although subjected to identical treatment; and have traveled practically side by side in the various conveying machinery. The weighing device mentioned is equipped with interlocking scales whereby proportional weights can be taken from the limestone and shale bins. This proportion is determined by chemical analysis of the material and the scales are set so as to secure the desired ratio. The bins are divided into three compartments which may be individually controlled at the scales. These divisions enable the analyzing of the contents of one compartment while the other two compartments are being filled and emptied respectively. The operation of this device, although automatic, entails some delay in the passage of the material; therefore to avoid clogging of the scale, separate conveyors are provided to carry away any excess of material and convey it back to the bin from which it was drawn.

The mixture, which is reduced in size to ¾ in. and under, is now conveyed to bins over Fuller mills. There are at present four of these mills, of the same size, as noted for the lime plant, and they are driven by and belt-connected to individual vertical 75 h. p. motors. These are placed on separate foundations and rotate at a speed of 162 r. p. m. From the Fuller mills the mixture passes by a screw and bucket conveyor to the charging bins for the rotary kilns.

Kilns and Coal Mill.—These kilns are 8 ft. in diameter and 120 ft. long, built of riveted steel plate, with a 9 in. lining of high silica brick. There are two such kilns, with provision for three more. They rest in bearings anchored to concrete piers, and are driven by individual 30 h. p. variable speed motors, located in a tunnel below the floor level for protection from dust. The kilns are equipped with variable speed motors on account of the interdependent relation between the speed of the kiln and that of the feed. They have a speed of about 2 r. p. m., an inclination of 1 in 24, and an operating temperature of 2500 deg. Each kiln is fed by a Buffalo pressure blower, direct-connected to a 10 h. p. motor.

At this point a digression is made to consider the method of handling coal for the blast to the kiln. A separate building, known as the coal mill, is devoted



Arrangement of Machines in Cement Mill

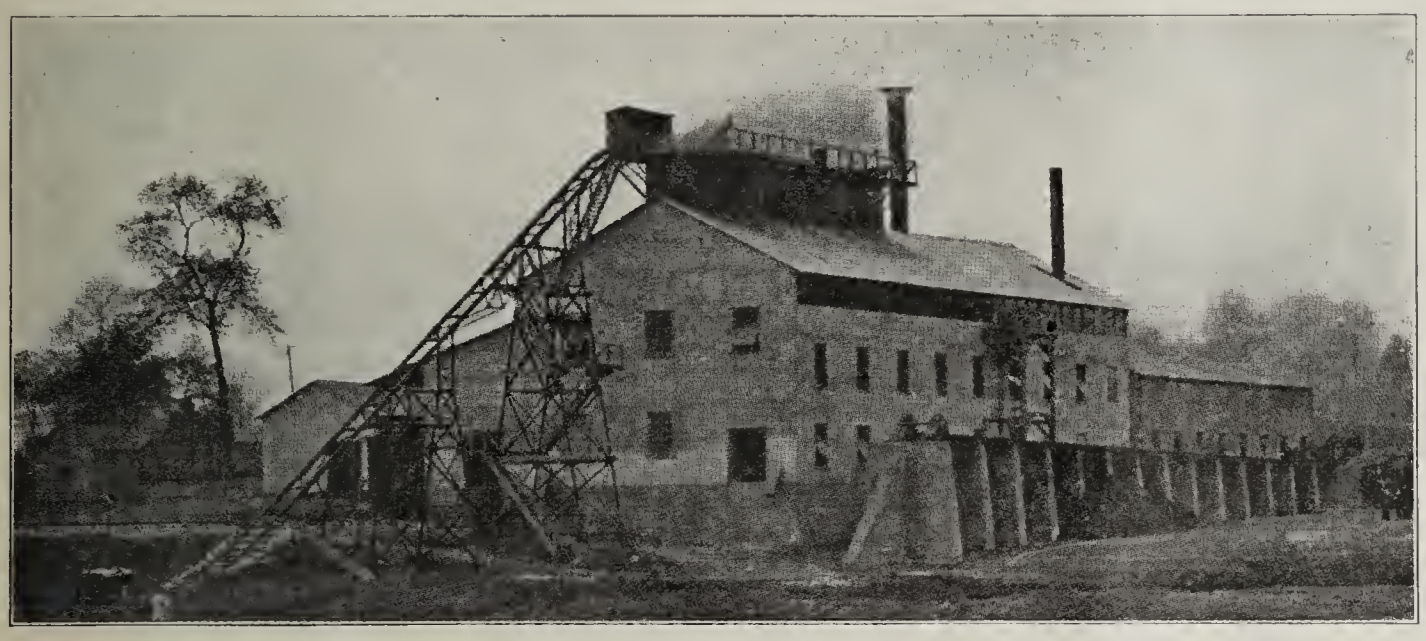
to this series of operations. The coal is first brought in on a trestle and dumped into a pile in the yard. By means of a tunnel under the yard it is then drawn onto a belt conveyor which carries it to crushing rolls at the north end of the mill. From the rolls the coal passes to bins equipped with automatically registering scales. After being weighed it is conveyed to and fed into a coal drier. This is of the type known as return draft drier and is made up of two concentric shells rigidly connected, with a fan at the upper end to create a draft. The coal is fed into the annular space between the two shells, and its passage through the drier is due to the inclination of the latter. In this drier the hot gases pass over and through the material in the direction opposite to its travel. From the drier the coal is conveyed to a 42-in. Fuller mill and from there to bins directly in front of the cement kilns. It is then fed to the blower and provides the hot blast for the kilns.

The Clinker.—The product of the cement kiln is known as clinker. It is a very hard dark brown material with a spongy structure. From the kiln it passes by a water cooled cast-iron chute directly into the coolers which are located in a concrete pit below the ground level. These coolers are 6 ft. in diameter and 61 ft. long. They are made of riveted steel plate with a lining of hard fire brick specially designed to

stand abrasion and are operated by individual 10 h. p. motors. They likewise have an inclination of 1 in 24. The lower end of these coolers is open and the shell is perforated with rings of holes through which the clinker passes to an inclined pan conveyor. An iron ball about 12 in. in diameter is placed at the lower end of the cooler and prevents the clogging of the perforations in the shell. An economy in the process results at this stage by passing the air to the cement kilns over the hot clinker, thereby preheating it. Each cooler has a separate pan conveyor which carries the clinker to automatic scales at the storage yard. A structural steel tower is located at the lower end of the yard, and this with other framework supports a bridge running the entire length of the yard. The scales are located at the tower and feed into a bucket elevator which conveys the material to a belt conveyor 20 in. wide extending the full length of the bridge. This conveyor is equipped with trippers at frequent intervals to permit unloading at any desired point in the pile. A careful record is kept by the chemist of the chemical composition of the various sections of

Storage facilities.—The stock house is divided into four rows of bins, eight bins to the row. This division is necessary in order to afford opportunity for inspection and sampling. These bins have steel frames and wood partitions with concrete hoppers. They are so designed as to be self-emptying. There is a tunnel under each row of bins leading into the basement of the pack house. The cement is drawn from the bins into a screw conveyor and lifted into bins over the packing machines. From these bins the cement passes to Bates automatic valve bagging machines where it is sacked for shipment. At present the cement is loaded into the cars with hand trucks, but it is stated that a movable loading belt is to be installed for that purpose. Shipping facilities are provided by a siding from the main line of the Western Maryland Railroad, directly connected to the track system of the plant.

Power Plant.—The power plant is designed and equipped for the ultimate capacity of plant. The boiler plant has a rated capacity of 2,020 h. p. with Rust water-tube boilers equipped with Roney stokers.



VIEW OF HYDRATED LIME PLANT BUILT FOR THE TIDEWATER CEMENT CO., SHOWING CONVEYOR FOR RAW LIME. THE KRITZER HYDRATER IS USED IN THIS PLANT.

the pile and he determines the distribution of the load. The surface layout is shown on the accompanying photograph. Beneath the clinker pile is a tunnel extending the full length of the pile, with chutes placed 10 ft. apart. The valves closing these chutes are operated by a shaft with a reciprocating motion adjusted so as to give control over each opening. These chutes feed onto a belt conveyor which connects with a bucket conveyor to bins over the clinker mills. It should be noted that material can be carried directly from scales to clinker mills either by upper or lower belt conveyor, without passing through the storage pile. The clinker mills are Krupp ball mills of the type previously described. Before passing to the clinker mill the material is conveyed to an automatic scale with two hoppers, one containing the clinker duct and the other gypsum. About 2½ per cent of gypsum is added to delay the initial set of the cement. With this it is stated that the cement would acquire an initial set in about two hours, while without the addition of gypsum the cement would set almost immediately. After leaving the Krupp ball mill the cement passes to a Fuller mill where the final grinding takes place. It is conveyed from there to an inclined belt conveyor 300 ft. long which carries it to the stock house.

The coal is handled outside the building by a bucket elevator and automatically weighed before entering the building. Inside the building an overhead coal handling apparatus serves the boilers. There are the customary boiler feed pumps and feed water regulators. The engine room has three main units with one exciter. The engines are Wisconsin Corliss cross-compound with 23x46x48 in. cylinders working under 140 lb. steam pressure. The generators have a capacity of 1,000 kw. There is one spare generator of 167 kw. and a Skinner high speed engine. The plant is operated under a 25-cycle, 550-volt alternating current. There is a well equipped machine shop, blacksmith shop and laboratory, and a store room for the handling of supplies.

Chemical analyses are made of the raw material before entering the mill, immediately before and after mixing, and of the finished product before entering the stock house. Samples are taken every hour for this purpose. Physical and chemical tests are likewise made of the hydrated lime. Two features of the plant are the use of individual back geared motors for the operating machinery and the placing of watt meters in the various departments. The first insures against more than a local shut down in the case of accident to one of the drives and the last enables the

determination of relative power consumption in various parts of the plant.

The company has built a concrete dam impounding the waters of a creek flowing through the property, and also a concrete bridge over which the lime cars pass to and from the quarry. This reservoir covers about three acres and furnishes water for fire protection and operating needs. The plant operates continuously, 24 hours a day, 7 days in the week. It employs somewhat over 100 men of whom 50 per cent are unskilled. The company has made some provision for the housing of the men employed, in barracks on the property. The construction and operation of the plant has been carried out under the direction of Mr. Richard K. Meade, formerly general manager, Mr. J. W. Dreisbach, operating superintendent, and Mr. H. C. Tompkins, mechanical engineer.

ROAD FOUNDATIONS.

The goods roads enthusiasts, who think that it costs nothing to maintain a good road once built, or who expect that present expenditures on road maintenance will be reduced by macadamizing all the highways, should be interested to know that in England, where practically all the public highways are macadamized the cost of road maintenance in the last year for which figures have been published was in the neighborhood of $65,000,000. In 1910 New York had 2,123 miles of new State Roads to maintain, and it expended on maintenance alone on these roads an average of $1,001.00 per mile. During 1911 the maintenance work was cut down so that only $1,000,000 was spent, but the result is that the roads are now badly worn and require immediate attention to save them from destruction. The Commission states that there are 200 miles of road which need surfacing, and about 1,000 miles which need a light top course of fine stone or gravel and oil treatment. The Commission requests an appropriation of nearly $3,000,000 for maintenance alone during the year to be expended on 3,151 miles of road, or an average cost per mile of $926.

Very different from this were the expenditures of Wayne County (Mich.) with maintenance charges for the county's concrete roads. From October 1, 1910, to September 30, 1911, their total expenditure upon 33 miles of concrete roads was $200, and this amount was used almost entirely upon ditches and shoulders—an expenditure of about $6.06 per mile.

Figuring the cost of one mile of concrete pavement with or without a bituminous wearing surface at $10,000 and figuring the annual maintenance charges on this type of pavement at $100 for a 30-year period, the total cost of construction and maintenance for 30 years of one mile of permanent pavement would be $13,000. The figure of $100 per year for maintenance of this type of pavement during the thirty-year period is undoubtedly high. The Wayne County pavements laid some three years ago require annually, during the three years, only $6 for maintenance. Pavements laid 17 years ago in Bellefontaine, Ohio, are in excellent condition to-day, give every promise of remaining in such condition during the rest of the 30-year period, and require a relative annual maintenance cost of approximately the same as is spent per mile on the Wayne County pavements.

On the other hand, macadam roads cost about $5,000 per mile and their average period of usefulness is about five years. This cost varies in Michigan according to figures taken from Bulletin No. 41 of the Office of Public Roads, U. S. Department of Agriculture, from $1,421 to $12,128 per mile. According to the same Bulletin, "Mileage of Cost of Public Roads in the United States," New York pays $8,428 per mile for 14 ft. macadam roads averaging five inches in depth. The average cost per mile with different stone is shown in the following table:

MISCELLANEOUS MACADAM ROADS, NEW YORK, 1909.

Material.	Cost per mile.	Average width, feet.	Av. depth of foundation, inches.
Local sandstone	9,009	14	5
Syneite	11,678	15	2
Local bluestone	8,112	14	5
Quartz	7,980	14	..
Granite	8,163	14	4
Local stone	10,346	14	6
Gneiss	9,857	16	4
Local shale	4,795	12	..

During their period of usefulness the maintenance charges of macadam roads vary from $200 to $300 per mile. After the five-year period, as we see by the New York reports, the maintenance cost varies from $926 per mile to $1,001 per mile.

Figuring the maintenance cost of macadam at $200 for the first five years, we have $1,000 for total cost of maintenance during the period. At this point we have the option of rebuilding the roads at another expenditure of about $5,000, which, to keep the roads in serviceable condition for a 30-year period, would mean an expenditure of $25,000, or we may begin paying $926 maintenance charges per mile. Twenty-five years' expenditure of this sum amounts to $23,150. And the total cost of construction and maintenance of one mile of macadam roadway for a 30-year period means a total expenditure of $29,150 as against $13,000 for the same charges against any one of the various types of pavement built upon a concrete base.

The new Department of Highways of New York is made up of three state officials, C. Gordon Reel, State Superintendent of Highways; John A. Bensel, State Engineer and Surveyor, and Duncan W. Peck, Superintendent of Public Works. We quote from the section of their report entitled "Types of Construction" as follows:

"The Commission desires to emphasize the fact that the work completed during the construction season of 1911 in no way reflects the policy of the present Commission, as it is intended to change the past method of construction as rapidly as possible whenever it has been found inadequate and unwise.

"The former Commission adopted a form of construction known as 'bituminous macadam.' It has been fully demonstrated that this class of construction has not given results such as would justify the increased cost. This Commission believes that it is impossible to obtain satisfactory results in highway construction until more attention is given to subsoil drainage, properly designed and constructed foundation, and a wearing course in which there is a more complete physical and chemical union of the units composing it; one which acts as a wearing course only and not constructed so that its main function is to assist an improperly drained and poorly designed foundation.

"Having these factors in view it seems wise, wher-

ever possible, to construct a foundation of concrete and to cover this with a thin wearing course composed of bituminous material and screenings of sand which is economical in first cost and easily and cheaply renewed. The foundation of a road, so constructed, is good for all time and the wearing course serves the purpose of carrying all classes of traffic without rubbing, raveling or raising a dust."

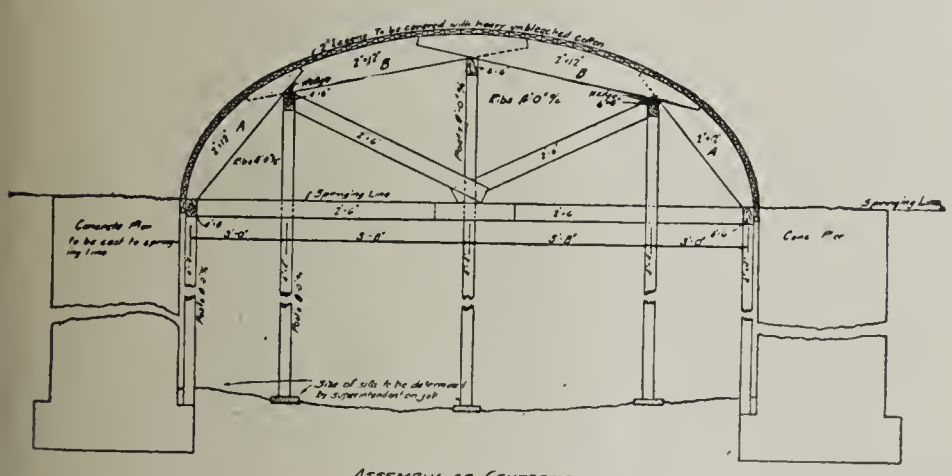
AN ATTRACTIVE CONCRETE BRIDGE AT METHUEN, MASS.

The recently completed "New Boardway Bridge" which spans the Spicket River on the road between Lawrence and Methuen, Mass., is an interesting example of what may be accomplished in bridge design with concrete when both utility and esthetic appearance are of importance. The bridge is a gift to the town of Methuen from Edward F. Searles, its most prominent citizen.

In designing the bridge the Aberthaw Construc-

METHUEN CONCRETE BRIDGE.

tion Company of Boston, Mass., who also built it, followed the suggestions of the donor. It was desired to erect a structure that would serve the traffic needs of the town to the best advantage and at the same time add as much as possible to the appearance of that section. Mr. Searles did not desire anything elaborate or ornate so the bridge was designed with almost severe plainness. It is to its very severity of



ASSEMBLY OF CENTERING ARCH.

architectural treatment that much of the attractiveness of the bridge is due.

The bridge is 80 feet long from the end of one abutment to the other, and 74 feet, 2 inches overall width. It has three arches, each 18 feet wide placed on 22 feet centers. The forms for these arches were detailed at the contractors' office so that there was no confusion nor delay on the job. The details of these forms are shown in the accompanying cut. The concrete footings are 5 feet wide and the piers themselves 4 feet thick. A 1:2:4 mix was used.

Across the central portion of the bridge run the double tracks of the Bay State Street Railway Co. On either side of the car tracks is a roadway, and flanking the roadways are two sidewalks 8 feet wide. The width of the roadway from one sidewalk curb to the other is just 50 feet. The road is of Macadam, and between it and the concrete bridge floor is a 3-ply waterproofing of felt and asphalt.

As will be seen from the photograph the parapet on either side of the bridge is without ornamentation, being simply a wall with plain capping. The parapet was chosen in preference to an iron railing as it added enough to the artistic appearance of the bridge to pay for the extra expense. At either end of the piers is a small buttress of uniform cross section which, despite its plainness, adds considerable to the appearance of the bridge. The surface of the spandrel and parapet walls are picked, while the edges of the arches, the floor, and the parapet capping were rubbed smooth.

Provision has been made for four electric light posts, one at each buttress. When these are installed, they will add to the general attractiveness of the bridge.

In putting in the piers a small coffer dam of 3-in. matched sheeting was sunk into the gravel bed of the river and the pier centering was hung from the horizontal sheeting braces.

A 16-in. water main that crossed the river at the bridge was provided for in the following manner. The pipe was carried on a 4-in. I-beam which rested on two trench braces at each pier. The braces placed side by side were expanded until the pipe was brought to the proper level. Then the concrete was poured around the braces and a permanent support at this level was assured.

The bridge is another to add to the long list of those built by the Alberthaw Construction Company and is in keeping with their reputation for high-grade concrete work.

MANAGANESE STEEL CHAIN.

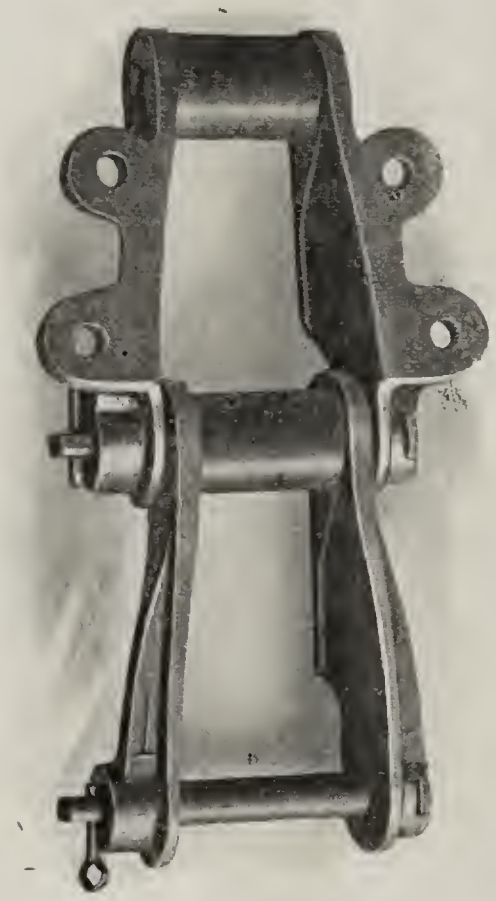
The Taylor-Wharton Iron & Steel Company of High Bridge, N. J., realizing the excellent wearing qualities of manganese steel, and in response to numerous inquiries for a chain that would stand up in severe service, have within the last few years entered into the manufacture of the standard types of chain in manganese steel. The trade in general have long recognized the value of this steel, especially when used in handling gritty and abrasive materials, and they have not been slow to adopt manganese chain, since it has proven to be the thing to overcome trouble experienced in the rapid wear of ordinary malleable and steel chains.

Manganese chain has gone through some of the most severe tests to which any chain ever could be put, and in every case the actual saving in dollars and cents has been so apparent that the higher initial cost does not enter into the consideration of upkeep. The matter of replacement is quite an item where breakage or renewal of equipment is frequent. For instance, cement mill engineers have, in the past, had no end of trouble with their malleable chain elevators wearing very readily, due to the abrasive action of the clinker being handled. This frequently results in a breakdown allowing the whole elevator to fall into the shaft. If this does not occur, frequent renewals are certain, and every minute of wasted time due to this idle equipment means an increased factor of cost per unit of finished product.

Manganese chain has not cured all the troublesome chain drives and elevators in the country, nor has it succeeded in proving its worth to all of the more skep-

tical; but it has, where once installed, shown its worth to such an extent that some of the largest mills in the country are now equipping throughout with it. One cement mill in the Middle West has had six hot clinker elevators equipped with maganese steel chain for about two years, and, even though malleable chain which it replaced wore out in from six to ten weeks, it now shows no appreciable wear, only having worn bright in places exposed to flexure.

The detachable type of chain was the first to be perfected in maganese steel. Owing to difficulties met with in casting, it is not practical to make any smaller size than No. 88 of this type. The No. 88 and larger are now on the market, all of which are interchangeable in every way with malleable link or chain belting. Aside from the many kinds of special chains now being made, practically all of the standard types for conveying and elevating work are on the market.



MANGANESE STEEL CHAIN.

The Combination and Leybushed, or Peerless, in manganese steel are finding very extensive fields of application, and are proving their worth in every case where the service calls for a wear resister.

Sprockets or traction wheels are made in manganese steel for all of the various types of chain, and are showing equally as good results as the manganese chain.

Only a few years ago mine and mill supplies were bought solely according to price. Fortunately, this is no longer true, for intelligent users realize that it is costly to dismantle and change parts of machines. The cost of the part replaced may be insignificant as compared with the loss of output during time of changing, while the breakage of a casting may also entail immense loss of life and property.

The great reputation made by this metal has led many to believe that it is a "cure all' for any trouble that may have been experienced with material which it replaces. This is not altogether true, as there are many good chains manufactured, each better adapted to handle the particular class of work for which it was designed. The first cost of manganese steel chain is, as a rule, higher than malleable or steel chain which it replaces, and it is necessary that its usé be recommended only where it will last enough longer to repay the user for the additional initial outlay.

With this in view, the manufacturers have endeavored to introduce manganese chain only where it is actually needed, which careful discrimination, along with the excellent qualities of the chain itself, bespeaks a steadily increasing demand from users who have the wear and tear of hard service to contend with.

OBJECT TO CEMENT PIPE FOR SEWER PURPOSES.

The San Diego Union, of Dec. 10, prints the following:

"Unqualified approval of the objections made by City Engineer E. M. Capps to the proposed laying of cement sewer pipe in San Diego was expressed by H. Clay Kellogg, a prominent consulting engineer of Santa Ana, who during a visit of several days in San Diego, has made a careful study of the situation in the interest of his own city and, in particular, familiarized himself with the output of the Glazed Cement Pipe Company. Mr. Kellogg, who as a hydraulic engineer, has had twenty-five years of practical experience, built the present Santa Ana sewer system in 1897 and the Corona sewer system in 1909. He is now engaged as consulting engineer in the construction of a sewer system in Orange and is also superintending sewerage extension work in Santa Ana.

"'My opinion may be of some value,' said Mr. Kellogg, 'as that of a disinterested outsider. Mr. Capps and I are as one, I think, in our objections to cement pipe for sewer purposes. In my experience it has never come up to requirements and I have never encountered any process of preparation that could make it do so. In the first place cement pipe cannot withstand the sewage acids. They eat into it and destroy it.

"'A further objection, which may not have been touched upon here, is found in the fact that in countries like Southern California, where the soil is dry, it is customary to grow shade trees on the streets adjacent to the sewer pipes. There is naturally some seepage at the joints of cement pipe, especially when it is new, which often forms so strong an attraction for the roots of these trees that in many instances they force their way in between the sections, causing leakage and often clogging and breaking the pipes."

CONCRETE-STEEL SAWMILL AT LAUREL EXPECTED TO START OPERATION JULY 1ST.

Wausau, Wis., lumbermen are the proprietors of a monster plant now rapidly nearing completion at Laurel, Miss. It is built by the Wausau Southern Lumber Company of which W. H. Bissell is president and S. B. Bissell, treasurer. The management expects to begin operations July 1. The opening of the plant is regarded as an important event in the industry, for when steam is turned on at the new institution for the first time the occasion will mark not only a new commercial era at Laurel, but in all yellow pine lumberdom.

The mammoth plant represents the last word in sawmill construction. Its innovations are numerous as well as radical. Not only are the sawmill and all of the buildings pertaining thereto constructed of structural steel and concrete, but the acres and acres of yards and loading platforms are made of the same material.

Pulverized Coal as a Fuel

By A. W. Raymond

The recent increased cost of crude oil has turned the attention of fuel oil users on pulverized coal as a substitute, instead of reverting to the old producer gas plant, and experiments which have been carried on along these lines have demonstrated not only its adaptibility and efficiency, but also its economy. When properly pulverized coal will yield higher temperature and more heat units per ton than can be obtained from a like amount of coal used in a producer gas plant while the equipment is about one-third the cost.

The method of burning the coal dust is very simple. A pipe conducts a blast of air into the furnace and the coal dust is automatically introduced into the air at a point about one foot from the nozzle of the pipe. Any method of feeding the coal, such as a screw conveyor, which will insure a regular and uniform feed will be found satisfactory. The temperature in the furnace and the length of the flame is very easily controlled by the velocity of the air blast and the quantity of coal dust mixed with it. In order to get complete combustion of the coal to carbon dioxide the mixture of air and coal dust must contain at least four times the calculated amount of oxygen required.

For the benefit of those readers who are in doubt as to the adaptibility of coal dust as a fuel, the writer would like to say that to his personal knowledge pulverized coal has been burned successfully for the last ten years in a number of large plants. Among these plants are the Canadian Copper Co., at Copper Cliff, Ont., Canada, where powdered coal is burned in the smelting furnaces, and the Chicago and Hamilton, Ont., plants of the International Harvester Co., who use it as the source of heat for their annealing ovens. These plants pulverize the coal to such a degree of fineness that 98.5 per cent of it will pass through a 100-mesh sieve.

The writer has also recently had occasion to come in personal contact with some experiments on a regenerative hearth furnace. Two heats of open-hearth steel have been made with powdered coal as a fuel and very even and high temperature were maintained with coal pulverized so that 91 per cent would pass a 200-mesh sieve. The checkers showed no sign of plugging and the steel was as free from sulphur as when producer gas or fuel oil is used. For these tests the coal was ground on a pulverizer depending on screens to get a fine product and it was clearly demonstrated that the cost of grinding the coal to the necessary degree of fineness on this type of machine was prohibitive, so the reader can deduce that all that is needed to make the use of pulverized coal a regenerative type of open-hearth furnace a success is a method of pulverization which will yield a product as fine, or, better still, even finer than 91 per cent through a 200-mesh test sieve.

The knowledge which has been gained from investigation, experiences, and comparative tests shows the Raymond four-roller mill, fitted with what the Raymond people call their vacuum air separator, to be an excellent method of pulverization which will answer the purpose. Averaging these tests which cover a period of over a year's time on fourteen pulverizers, the cost per ton of pulverizing the coal so that 99.5 per cent will pass a 100-mesh test sieve amounted to $0.325. This figure includes the power used at a cost of 1.5 cents a kilowatt hour and shows a saving of $0.211 per ton over any other method with which it was compared. Though the above tests only proved the necessity of a finely pulverized coal on a regenerative type of furnace, the writer holds to the belief and feels confident that the reader will agree with him that the highest efficiency in any or all cases can only be obtained when the coal is ground extremely fine and uniform. Let us now take up the process of properly preparing the coal for the burners step by step:

The coal must first be crushed so that it will all pass through a ring 1¼ inches in diameter, as there is no machinery made which will reduce the ordinary mine run of coal to the required fineness in one operation. Though not absolutely essential, it is generally conceded that the crushed coal should be dried thoroughly before pulverizing or burning, as dried coal can be pulverized with 15 per cent less horsepower than the wet, and it is almost axiomatic to say that dried coal is more easily ignited and consequently gives higher temperatures and less ash. Actual experience has proven that drying the coal before pulverizing or burning it is a money saving practice. Excellent drying apparatus is manufactured by the Ruggles-Coles Engineering Co. After the coal is thoroughly dried it is ready to be fed into the pulverizer and the necessity of using the right kind of pulverizing machinery cannot be too strongly emphasized.

The pulverization of coal entails no danger from spontaneous combustion, providing the necessary precautions are taken. The pulverizer used must be one which does not heat up the coal; that is, one in which the friction is reduced to a minimum, and the danger of sparking against any iron in the coal is eliminated. A ball mill is unpractical because the pusher plates behind the balls get very hot and will invariably cause the coal to take fire.

The first step is to select a pulverizer which delivers a cool product so that it can be safely stored for a day or two. Investigation will show the Raymond mill, before referred to in this article, to be such a pulverizer. This mill has another very important advantage in that the coal is never allowed to settle in the grinding chamber and for this reason the danger of an explosion in the pulverizer is entirely eliminated. These mills have been grinding coal in the United States and Canada for the last ten years and there is no record of any explosion or fires in, or resulting from, them. There is also another point to consider in the selection of a pulverizer.

The efficiency of combustion depends entirely upon the degree of pulverization. In other words, the finer the degree of pulverization the more economical the operation, the higher the temperature obtained and consequently a low percentage of a finely divided ash. In a regenerative type of furnace a low percentage of ash in a very finely divided state is absolutely essential, as anything else would clog up the checker work. Therefore, the coal must be pulverized very fine, the degree of fineness being determined by the cost of grinding as this cost must be kept as low as possible in order to make a powdered coal burning installation more economical than a producer gas plant. Here again we find the Raymond mill peculiarly adapted to coal grinding. The capacity is not limited, as in the case of a screen pulverizer,

to the capacity of the screens, but every atom of power put into the mill is used in grinding the oversized coal, as the pulverized coal is removed immediately by the vacuum air separator. This principle is the very essence of economy as there is no waste of power.

Not only must the coal be very fine, but it must also be very uniform. Nothing but a very uniform pulverized coal will maintain the steady and even temperatures which are required in almost every case. Particles of coal too large to pass an 80-mesh mean a resultant ash which contains a great many unused British thermal units, consequently, economical operation requires a very uniform degree of pulverization, which is impossible to obtain in a screen machine. A test made in the coal house of the Huron Portland Cement Co.'s plant at Alpena, Mich., and covering a period of six days showed that the coal ground on Raymond mills did not vary more than 0.2 in the percentage which passed a 100-mesh test sieve; in other words, the coal was ground so that never less than 98.4 per cent or more than 98.6 per cent would pass a 100-mesh test sieve.

The next question is, what is the cheapest method of pulverizing? In the writer's opinion the following figures obtained from the Omega Portland Cement Co. speak for themselves. These figures are averaged for a year's time and the coal was ground so that 98.5 per cent would pass through a 100-mesh test sieve. In the one case the coal was ground in a Raymond mill and in the other it was pulverized in a hammer cage mill and finished on a tube mill. The cost of operation and repair, not including power, on the hammer cage and tube mill combined was $0.336 per ton, while on the Raymond mill only $0.125 per ton, and the power required on the Raymond mill per ton of coal ground was a little less than half that required for the other method. Other tests comparing the Raymond mill with a ball mill used in the place of the hammer cage have substantiated the above figures.

The use of the Raymond mills in other large cement plants has resulted in a saving of two-thirds the labor and an increase of 12 per cent in efficiency of combustion due to the high percentages of impalpable powder which is obtained by the Raymond system. One cement plant was able to make 13,500 tons of coal ground on Raymond mills, burning the same amount of clinker, as 15,120 tons ground by a different method would burn.

In brief, then, the installation for properly preparing the coal most economically should consist, in the writer's opinion, of gyratory crushers, Ruggles-Coles dryers and Raymond roller mills with vacuum air separators.

THE NEW BUTLER BROTHERS BUILDING IN CHICAGO.

Business men generally are realizing more and more that reinforced concrete construction is far superior for industrial housing to any other known type of building.

A very convincing proof of this fact has been given recently. Butler Brothers, of New York, Chicago, St. Louis and Minneapolis, very large distributors of general merchandise to variety stores, were forced to add another building to their Chicago quarters.

The two they already had were brick. The new one now being rapidly pushed to completion is concrete.

That certainly indicates the trend of the times in building construction. Concrete construction is economical from the standpoint of lowering the cost of fire insurance to the owners. The combination of this with many other factors tending toward final low cost, is making concrete the favorite more and more. There are certain features of the work on this Butler building which will not fail to interest any practical concrete man. In the first place, it is the largest reinforced concrete building in Chicago, covering over 800,000 square feet of floor space in fifteen stories, a basement and sub-basement. The illustration gives a good idea of what a huge structure it is.

It contains a commodious gymnasium, restaurant, and well-appointed roof garden, showing forethought in the care of employes, as well as the selection of permanent and fireproof building material.

One of the most interesting features of the work from the standpoint of the practical man is the great rapidity with which the floors were laid. Wells Brothers were the contractors for the complete construction, with the floor contract sublet to Rudolph S. Blome & Co., the concrete pavement contractors.

Work began on the floors September 12, 1912. They were completed January 15, 1913—800,000

square feet in four months, 200,000 per month. The weather toward the end of the work was a typical Chicago winter, but work was not interrupted at all, salamanders being used, and the cement being delivered promptly as needed.

The cement supplied for the entire building was ATLAS—"The standard by which all other makes are measured."

One factor which always seems to bear on work of this character is worthy of more than passing interest. When the owners of any prospective construction are anxious to secure the highest type of work and material, "Atlas" is often seen in the finished work.

D. H. Burnham & Company, of Chicago, are the architects. The building is well designed to meet the exact requirements of the business, and should serve as a model of up-to-the-minute commercial housing.

EARNINGS CANADA CEMENT CO.

For the year ended Dec. 31, net earnings of the Canada Cement Company were $1,394,677, an increase of $12,638; balance after charges $1,019,259, an increase of $5,450, and surplus of $284,259. The total surplus is now $781,062.

THE NEW NEWAYGO SCREEN FACTORY.

The illustration shows the new home of the well-known Newaygo screen. Built entirely of concrete, it is fireproof, and one of the most up-to-date plants; in fact is the largest plant in the world devoted exclusively to the manufacture of vibrating screens. It is fully equipped with the most modern tools for turning out large quantities of high class screens.

It is located on the bank of the Muskegon river at Newaygo, Mich., about thirty miles north of Grand Rapids. A spur track of the Pere Marquette railroad gives, as the photograph shows, excellent shipping facilities.

The output of this plant is 1,000 Newaygo screens per year and has been for the past few months over 100 screens behind its orders. This shows the popularity of the Newaygo screen, as all of its output is confined to this country. A large factory in England supplies the foreign demand.

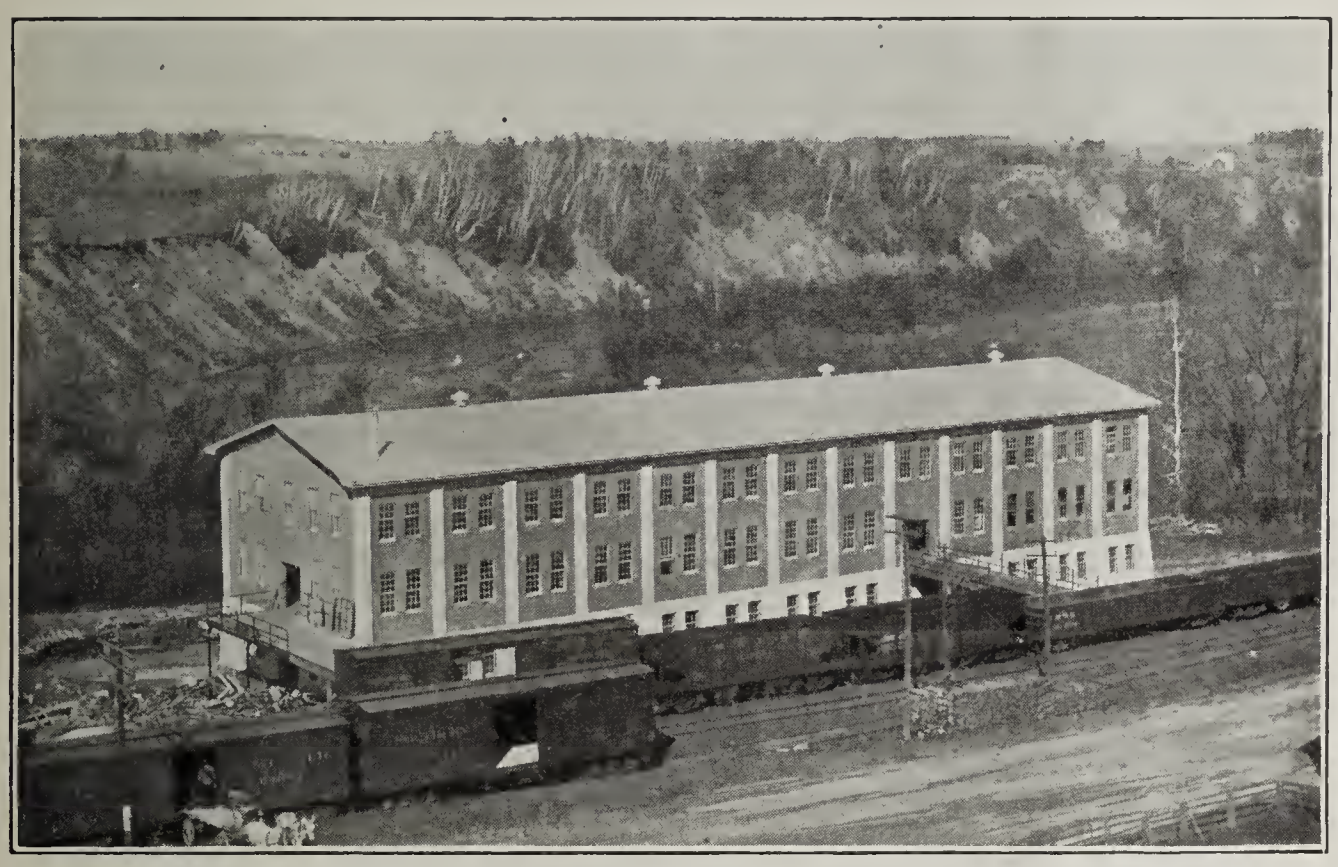
The separators are used for a great variety of materials, in fact, for most everything screenable between 4 and 180 mesh. To show its well deserved merit among large users of separating devices, where it has become "standard equipment," we might state that one large fertilizer combination uses 78 Newaygo screens in its various plants; another concern 40; another 38, and many from 4 to 20. In the cement field one manufacturer has installed 64; another 20; two other 17; etc., etc., etc. For screening cottonseed meal, gypsum, talc, lime, limestone, ore, chemicals, coal and a great variety of other ground materials it is recognized as one of the best.

When one realizes that four separate and accurate products may be obtained from a single separator in large quantities and that it can easily handle many materials which are practically unscreenable by other methods, it is no wonder that such a machine has, in a measure, cornered the screen market.

The entire product of this plant is sold by the Sturtevant Mill Co. of Boston, Mass., and many screens are used in connection with its well-known crushing and grinding machinery.

The Newaygo screen was developed in the Newaygo cement plant, where 17 of them were used for years, so, unlike most new machines, it was proven thoroughly practical before being offered to the public. W. J. Bell, formerly superintendent of the Newaygo Portland Cement Co., its inventor, saw its possibilities and arranged for its manufacture in an old furniture factory. The Sturtevant Mill Company also appreciated its merit, so a combination was formed to market it on a large scale, which has been done, resulting in a fine new plant and a large and satisfactory screen business, which looks as though even the present manufacturing facilities will be inadequate to supply the increasing demand.

Mr. Bell has formed a corporation to conduct the screen manufacture, known as the Newaygo Engineering Co., of Newaygo, Mich., and has employed an expert cement engineer, who, with Mr. Bell, has designed and erected a number of cement plants. Thus the engineering company, as the name implies, will conduct an engineering business in connection with the Newaygo screen manufacture, making a specialty of cement and other plants where crushing, grinding and screening machinery are used. With this long and successful experience in this line, their services and advice should prove valuable to users of such machinery.



EXCELLENT TYPE OF CONCRETE STEEL FACTORY CONSTRUCTION. PLANT OF THE NEWAYGO ENGINEERING CO., MANUFACTURERS OF NEWAYGO SCREENS, NEWAYGO, MICH.

THE NEW BUILDING ESTIMATOR.

The New Building Estimator is a practical guide to estimating the cost of labor and material in building construction, from excavation to finish; with various practical examples of work presented in detail and with labor figured chiefly in hours and quantities. A handbook for architects, builders, contractors, appraisers, engineers, superintendents and draftsmen—by William Arthur. Eleventh edition, revised and enlarged. Williams Co. Flexible leather; 4½x7 in.; pp. 713; illustrated. $3, postpaid. Can be supplied by Cement and Engineering News, 1117 Schiller Bldg., Chicago, Ill.

"UNIVERSAL" AT THE CEMENT SHOW.

The Universal Portland Cement Co. has never had more interesting exhibits than those shown at the Chicago Cement Show, January 16 to 23, at the Coliseum. They consisted of a paving determinator, owned by the City of Detroit and which showed, during the show, the comparative merits of brick, creosoted wood blocks, macadam and concrete paving materials; a fireproof, concrete house which illustrated the highest class of building construction; a bulk cement exhibit that presented the advantages of handling cement in bulk rather than in cloth sacks; a sack exhibit illustrating the proper methods of bundling and handling sacks; a concrete aggregate exhibit which demonstrated the need for careful selection and inspection of sand, gravel and stone; and a relief map showing the location of the Universal cement mills at strategic railway centers, making for prompt shipments to all points.

A FIREPROOF CONCRETE HOUSE—A DEMONSTRATION OF GOOD BUILDING METHODS.

The paving determinator was easily the most startling exhibit of the show. A vertical shaft carried two long arms on the ends of which were placed two disks of cast iron with three-inch treads, each weighing 1,400 pounds. As the shaft turned, these disks rolled over the pavement specimens at a rate of approximately three and one-half miles per hour. The disks gave an approximation of the wear from vehicular traffic and in addition to this there were five horse-shoes attached to each, which struck the pavement with a blow of 150 pounds each, simulating the effect of horses' hoofs. The pavement sections were built up according to the several specifications most commonly used and consisted of (1) two sections of brick with cement filler and bedded upon 1½ inches of cement mortar foundation, (2) a section of creosoted wood blocks, (3) a section of macadam which, however, was so soon worn out by the wheels that it had to be replaced after the second day and (4) several sections of concrete built according to the best specifications covering one and two course work.

PAVING DETERMINATOR TESTING SAMPLES OF STREET PAVEMENTS.

Although the macadam section was not taken out until after the second day, it really was torn to pieces after the first hour; about every fifteen minutes it being necessary to shut down the machine for repairs

to the macadam. Several remarked that this particular section more resembled a garden than a pavement. No one expected, however, that macadam would compare with concrete, and so the other permanent paving materials mentioned were included in the demonstration. Concrete compared very favorably with the more expensive materials, showing practically no surface wear, and proved itself the cheapest permanent pavement when adaptability, cost and durability are considered.

The number of people gathered about the fireproof, concrete house in the annex proved that all the visitors, whether engineers, contractors, architects or business men, had one interest in common. All were interested in a fireproof house and what it stood for in comfort, in safety from fire, in freedom from repairs and painting and in home-like appearance. It dispelled to a great extent the thought that a fireproof house must be ugly; that features of beauty must be sacrificed to attain a truly fireproof building. The front wall of the house, with a casement-windowed bay in the living room, the porch partly roofed and partly open, were actually built using concrete hollow tile. The balance of the house was painted on canvas in true perspective. Vines, potted plants and palms, carried out the effect of a garden on either side. It was easily the most attractive exhibit of the show and moreover one which had a real purpose; proving that it is worth while to work for freedom from fire danger and that nothing need be sacrificed in comfort or beauty by using fireproof materials.

In the bulk cement exhibit there were wheelbarrows of sand in bulk and of cement in bulk and placards with the inscription, "You buy sand in bulk, why not cement?" It is a question that no one answered successfully during the show. There was also a bin full of loose cement and it was surprising to many that no dust was thrown about, even under rather careless shoveling.

The standard dealers' sack cabinet, which the Universal Company has advocated for dealers' use, was also shown.

The exhibit of concrete aggregates was perhaps the most valuable to concrete workers. A striking demonstration was that showing one flask of bank-run material, two flasks showing the sand and gravel separated, and a block of concrete showing the volume which a proper admixture of cement to the bank-run would make. Alongside of these were flasks, one containing the same amount of sand as in the other set, another containing the amount of stone which should have been mixed with it for a proportion of 1:3:6, and beside it a block of concrete almost twice the size of the first block, showing the volume of the concrete resulting from the same amount of cement and sand, but with enough gravel added to make up for the deficiency in the bank-run. Thus, by adding a comparatively small amount of gravel, double volume of concrete was obtained with no sacrifice in quality. There were many other specimens of bank-run material in flasks and beside each the sand and gravel separated. Not one sample of bank-run was of a proper proportion. Most contained two of sand to one of gravel, some as much as three to one, which

EXHIBIT OF CONCRETE AGGREGATE, SHOWING THE NEED OF CAREFUL SELECTION.

easily demonstrated the need of screening and remixing bank-run materials in the proper proportion.

There was also a relief map of the United States, showing the Universal mills at Chicago and Pittsburgh as centers of railway lines reaching every point in the country with a minimum of transfers and distance. Chicago and Pittsburgh are the two greatest railway terminals in the world and the map graphically illustrated this. It was not difficult to see the close connection between this exhibit and one of the problems confronting the concrete worker. The shipment of cement must be prompt, must go through with a minimum of delay in transfers from road to road and the actual mileage is a considerable factor in the cost of cement. The strategic location of the Universal mills is a real advantage to users of Universal Portland cement.

The Chicago Cement Show was a success. Over 15,000 attended on the first night. The Cement Show has become an institution of broad, popular appeal to the people of Chicago and the middle west.

A VENEZUELA CEMENT MILL.

The Bradley Pulverizer Company, Boston, Mass., announce that they have just received an order from the National Cement Company of Caracas, Venezuela, for a Giant Griffin Mill installation.

CONTINENTAL DUMP CARS.

There is a vast difference between the Dump Cars built years ago and the product of today of the Continental Car & Equipment Co., manufacturers of the "Continental" Dump Cars.

Their present car is frequently referred to among contractors, cement manufacturers and producers of gravel and crushed stone and other users of this class of equipment as the "Efficient Dump Car," the car that will stand up under the work, no matter what the conditions. It surely is a relief to a contractor to know that he has a plant which he is sure will not cause him trouble and which will or is bringing in profits.

While it is true that their present car is more costly than the old type, it must be remembered that this company has expended a large sum of money to build the most rugged and best dump car and the improvements which have been incorporated in their cars have necessarily increased the cost of building them. It will be remembered however, that the additional price paid by purchasers for a good car is more than offset by the additional efficiency, and the smaller repair bills which means more efficiency and in the end more profits.

The general design of the present "Continental" dump car is the same as years ago, with but few changes. The improvements, however, consist of better and stronger materials and the strengthening of members of the cars that have shown tendencies to weaken under abnormal strains. The woodwork used throughout is of the best quality Southern Indiana white oak. The wheels have proved to be exceptionally strong and in the ten years that they have been manufacturing dump cars, the company claims that less than 5 per cent of the wheels have worn out. At the present time 108 4-yard cars built in 1903 are still working for the Pinkerton Construction Co. at Webster, Mass. on the new Grand Trunk line. The original purchase of the Pinkerton Construction Co. consisted of 125 four yard cars. It is known that the 125 cars have handled over three and one-half million yards of rock and earth, which means that each car has handled twenty-eight thousand yards, and that each car has been dumped and righted seven thousand times.

The present product of the company is a great improvement over the cars above referred to and they should beat the record of the older cars.

The more recent improvements in these dump cars are as follows:

Increased thickness of oak timbers in the floors from 2½-in. thick to 3-in. thick, and in the doors and ends from 2-in. thick to 2½-in. thick.

Equipping the doors and ends with protecting angles, and two heavier truss rods on each door.

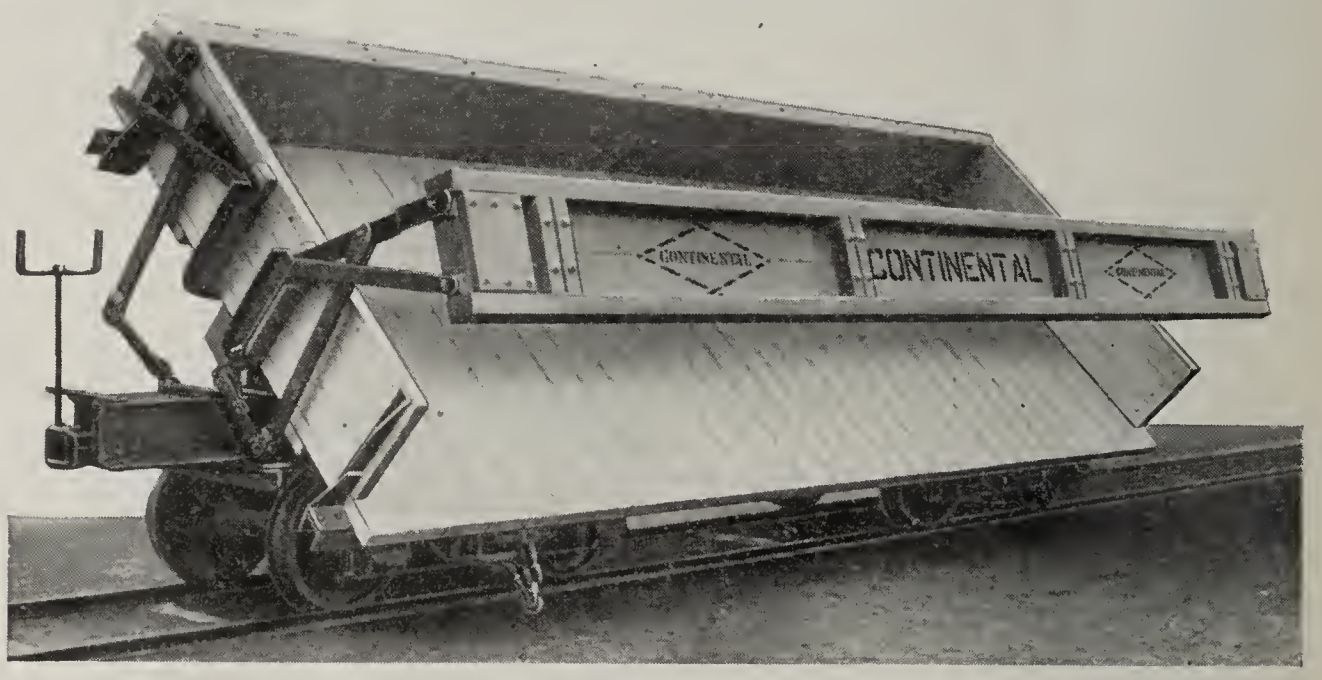
The patent end bracing and door arm arrangements give the ends of the cars exceptional strength in resisting loads from pushing the ends out which permits a large door displacement when the car is dumped. It is claimed that no other dump car on the market has as large a door opening.

The dumping angle has been increased from 45 degrees to 48 degrees.

The use of malleable castings throughout in place of grey iron castings.

We reproduce a photograph taken of a train of "Continental" 4-yard dump cars, eight of this type having recently been shipped to Spain.

A general catalog of the Continental Car and Equipment Co. giving full information concerning its products may be had by addressing them at 45 East Seventeenth Street, New York City, N. Y.



CONTINENTAL DUMP CAR.

NEW BOOK; TESTING MATERIALS.

Laboratory Manual for Testing Materials of Construction. By L. A. Waterbury, C. E. Wiley & Co. Pp. 270, index. For sale by Cement & Engineering News, 1117 Schiller Bldg., Chicago. Price $1.50.

As the title implies, this book is written for the use of students as a text-book in laboratory testing practice. The subject matter covers testing of all known building materials, and is treated under the heading of general instructions, laboratory work, preparation of reports, description of apparatus, tests of cement, tests of concrete, concrete, iron, steel, wood, brick, sand, gravel, stone, and asphalt. Appendices supplement the matter in the body of the text and give the reports of the sub-committees of the various engineering societies bearing upon the subject, and include progress report on uniform tests of cement, standard specifications for cement, method suggested for the analysis of limestones, raw mixtures, and portland cements, progress report of special committee on concrete and reinforced concrete; standard specifications for structural steel for bridges and buildings, standard specifications for open-hearth boiler plate and rivet steel, and requirements for paving brick. The entire book is comprehensive in its treatment of the various subjects and replete with information.

SAND AND GRAVEL NEWS.

Judge Jeff W. Hassell, Sherman, Texas, just returned from Austin, Texas, where he went before the state railroad commission in the interest of the good roads work in progress in the Sherman precinct.

It had been proposed to have a readjustment of freight rates, and in the readjustment for Texas the rate on gravel, which is now 40 cents per ton into Sherman, from the gravel pits in Dallas County, would have been raised to 44 cents. Judge Hassell was successful in getting the rate to remain as it is.

Mississippi Sand Co., Alton, Ill., increased its capital stock from $30,000 to $75,000. The company will erect big storage bins on the river bank above the city. The sand will be sucked from the bed of the river and carried into the bins.

A NEW SAND AND GRAVEL PLANT IN SAN DIEGO, CAL.

A large sand and gravel pit has been opened in the Otay valley. It is owned by Fenton, Sumption & Barnes, a new firm composed of H. G. Fenton, grading contractor; H. W. Sumption, the concrete pipe manufacturer, and Theodore L. Barnes, who has been engaged in the sand and crushed rock business for several years.

The pit is located on the southern division of the San Diego & Southeastern railway, the Tia Juana line, overlooking the tracks of the San Diego & Arizona railroad. A $20,000 plant has been installed there for removing and refining the building material and about ten carloads of rock and sand now are being shipped daily.

The same firm now is erecting large bunkers on Newton avenue near Thirteenth street in the yards of the San Diego & Southeastern railway. This structure will be used for storage purposes. It will have a capacity of about twenty carloads. The material will be transferred from the cars to the bunkers by means of a steam shovel, and as needed will be drawn from the bunkers by gravity and loaded into wagons or auto trucks.

MILL BUILDINGS AND FACTORY PLANTS.

An important book, "The Design and Construction of Mill Buildings and Other Industrial Plants," has just been published by Henry Grattan Tyrrell, C. E. It is a work on the economic design and details of actual construction. Covers the practical features related to the subject with variety and fullness. The text is profusely illustrated with well made drawings, amplified with tables and useful cost data. Treats structures of Steel, Concrete and Wood, giving the comparative merits of each style. Being free from involved mathematics, it recommends itself to all structural engineers or designers of mill buildings and industrial factory buildings.

"Mr. Tyrrell has produced not only a new book, but one that affords by far the largest and best collection of practical information on Mill Buildings yet published. * * *

"The Book before us gains in value by devoting itself wholly to general arrangement, construction details, and working data," says Engineering News of Aug. 17, 1911.

Size 6x9 inches, 500 pages, 650 illustrations. Price, $4.00 net, postpaid. Can be supplied by Cement & Engineering News, Schiller Bldg., Chicago.

Making Wonderful Endurance Records in the Cement Mills

The success of Longlife Conveyor Belts is a plain case of "survival of the fittest." When mills similar to yours come back repeatedly with orders covering their conveyor belt requirements—what stronger evidence of merit can you ask? Over 14,000 feet of

Longlife CONVEYOR BELT

have been shipped this year, to date, to the Universal Portland Cement Company. This belt is handling hot stuff, too.

This concern finds the use of "Longlife" is insurance against interruptions and shut-downs.

Next Time You Need a Conveyor Belt Specify "Longlife" in Your Requisition

B. F. GOODRICH CO.

Makers of Goodrich Tires and Everything That's Best in Rubber

Factories, Akron, Ohio **Branches in All Leading Cities**

SAND AND GRAVEL LEASES RESCINDED.

All leases for the mining of sand and gravel in the beds of the Arkansas and Grand rivers are rescinded in accordance with resolutions passed Tuesday morning by the commissioners of the land office, and a report of this action was made to the house and senate. The resolutions review the part played by the Builders' Sand and Gravel Company, Oklahoma City, Okla., in agreeing to relinquish their lease, the advertising for bids of which none was accepted, the action taken Tuesday and include in their resolutions a copy of the formal relinquishment made by the Builders' company. At the meeting which was attended by Governor Lee Cruce, Secretary of State Ben Harrison, State Auditor Leo Meyer and State Superintendent of Public Instruction R. H. Wilson, all voted in favor of the resolution, says the Oklahoma City Tribune.

On June 10, 1912, the Builders' Sand and Gravel Company addressed to the board a communication offering to enter into a supplemental contract changing the lease granted to them and agreeing that the board advertise for other bids and if in their judgment the rights of the state would be better protected, to abrogate all the rights conferred on the company. At this time new bids were advertised for and one was submitted by A. D. Krow of Ralston for a portion of the river beds and another by the Sequoyah Sand Company for a larger amount than that asked by the Builders' company. But no action was taken on the proposition until the title of the state to the river beds was established by the action of the legislature on the question of the repeal of section 254, Snyder's Compiled Laws, relating to the rights of riparian owners along navigable streams.

For the reason that the Builders' Sand and Gravel Company claimed no rights and that no other lease had been granted, it was resolved by the board that all bids be rejected. The motion was made by Secretary of State Harrison and received no dissenting vote.

SAND FROM RIVER BEDS.

After a long argument and many vain attempts to amend the house last night recommended for passage the bill introduced by J. T. Kincaid of Johnson county and prepared by State Auditor W. E. Davis; providing that the state shall receive a royalty on the sand taken from the Kaw and Arkansas rivers. The bill places the beds of the streams under the jurisdiction of the state executive council and authorizes that body to fix rates upon the sand and gravel, says the Topeka, Kans., Herald.

Nothing in the act prevents the taking of sand and gravel from the river beds for the improvement of public highways, the erection of public buildings or for the exclusive use of the person taking it. It applies only to sand that is to be sold. It is intended to apply to the sand companies doing business along the rivers.

There was a great deal of opposition to the main provisions of the bill, although I. N. Williams of Sedgwick county opposed it in every respect. He held that the state might as well charge a royalty on the water taken from the rivers.

Mr. Kincaid defended his measure on every point of attack and did a good job of it. It was the matter of amendments that provoked most of the discussion.

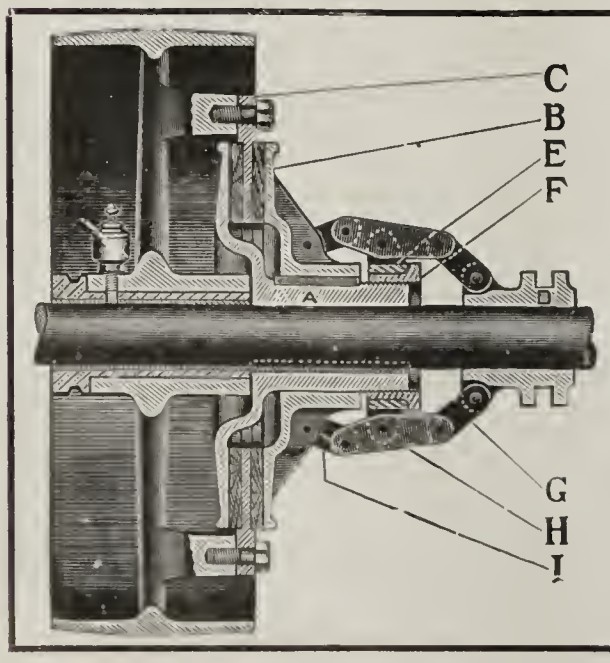
S. T. Jocelyn of Sedgwick county offered an amendment providing that the bill should not affect contracts made prior to January 1, 1913, and gave his reasons. He stated that contractors had bid upon the work of making immense "fills" for the union depot at Wichita on the basis of existing conditions and that it would cause them a loss to fix a higher rate upon the sand than that upon which they had based their bids. But the house refused to feel sorry for the contractors and voted the amendment down.

W. W. Gordon of Wyandotte county and Fred Voiland of Shawnee county made a fight for an amendment that would have permitted drainage districts like those existing in North Topeka and Kansas City to collect the royalty on the sand and gravel and use it in furthering the interests of the districts. They won their fight, then lost it. They won the house over to their way of thinking and placed the amendment in the bill, then a motion was made that the committee arise. A recess was taken for the evening meal, and when the house reconvened the fight had been lost. The vote was reconsidered and the amendment relating to drainage districts was stricken from the bill. Gordon and Voiland had attempted to prevent the committee from arising, but failed.

Mr. Voiland placed in the bill an amendment giving the state jurisdiction over oil, gas and minerals, in addition to sand and gravel in the beds of the streams.

CHEMIST.

The Pacific Portland Cement Company, Cement, California, write us that they are looking for an assistant chemist, with cement experience. Their plant has a capacity of 6,000 barrels of Golden Gate cement, and is equipped with twenty-one 60 ft., 80 ft., and 100 ft. kilns.



PLAMONDON

DISC TYPE FRICTION CLUTCHES

ARE GUARANTEED THE BEST FOR

CEMENT MILL SERVICE

USED AND ENDORSED BY ALL THE LEADING CEMENT MILLS

SIMPLE—POWERFUL—NO SPRINGS OR BOLTS—ONE ADJUSTMENT ONLY—NOT AFFECTED BY CENTRIFUGAL ACTION OR DUST. LET US DEMONSTRATE TO YOUR SATISFACTION.

WRITE FOR CLUTCH CATALOG C. I.

A. PLAMONDON MFG. CO.,

12 TO 24 N. CLINTON ST., CHICAGO, ILL.

GRAVEL MEN DENY PRICE AGREEMENT.

Since the organization of the sand and gravel interests in Portland, Ore., and the establishment of a central selling agency for dealers a few weeks ago, the prices have been doubled and drayage charges have been advanced materially, according to information that has reached the Builders' Exchange. Several contractors engaged in heavy construction work in the city also declared yesterday that a sand and gravel monopoly exists and that all material handled by the firms represented in the organization must be secured through the central selling agency.

On the other hand the sand and gravel men say that there has been no agreement or tacit understanding among them to raise the prices of material and cartage, but admit that a central selling agency was established for the purpose of obtaining mutual protection from unreliable contractors as well as preventing ruinous competition. They declare that inasmuch as they are carrying unpaid accounts on their books aggregating about $500,000, they are justified in centralizing the business not only for the purpose of self-protection from dishonest contractors, but also to establish uniform charges that may return a reasonable profit.

Banker Explains Agency.

George W. Bates, of the banking firm of George W. Bates & Co., who is said to have been active in organizing the selling agency, yesterday did not deny his connection with the sand and gravel situation.

"The purpose of the agency was explained previously in an article published in The Oregonian," said Mr. Bates. "The object is mutual protection. As far as a combine is concerned such a thing would be impossible, as there are too many independent gravel pits around Portland. Some of the concerns have been losing money at prices that prevailed for sand and gravel, and if they have raised the prices a little, it was necessary in order for them to continue in business."

A directly opposite side is given the situation by one of the prominent building contractors, who said:

"It may be true that the sand and gravel dealers have lost money by their dealings with certain persons, but it is equally true that since the central selling agency was established the prices of the material have advanced from 40 and 50 cents a cubic yard to $1 a cubic yard.

"I am informed that it costs 30 cents a cubic yard to deliver sand and gravel at the docks. All above that figure would be profit. Fifty cents a cubic yard is a fair price, but the dealers are now asking $1.

Investigation Suggested.

"It is impossible to get sand or gravel except through the central selling agency. If this doesn't look like a combine, what does? I think the situation is growing serious for the building trade of the city. It may be timely for the Legislature to investigate the matter."

It is declared that the dealers also have agreed upon a sliding scale in drayage charges, adding 20 cents for each one-half mile of cartage. It is said that small contractors, engaged in house construction and building of concrete sidewalks in the outlying districts, will be unable to meet the prices demanded and will be compelled to go out of business unless the situation is adjusted.

It was announced yesterday at the Builders' Exchange that a complete investigation would be made, and if the complaints of aggrieved contractors are found justifiable, charges will be filed against the firms interested in the agency.

Silo Builders—Attention!

The roof is made in sections and bolted together on top the silo. Each joint has four thicknesses of metal, which gives a girder or rafter effect, making it self-supporting without the use of a frame. The middle part of one sheet lifts up like a trap door or is removable for filling purposes.

We use the very best heavy galvanized material, 26 gauge, and guarantee the material and workmanship to be the best.

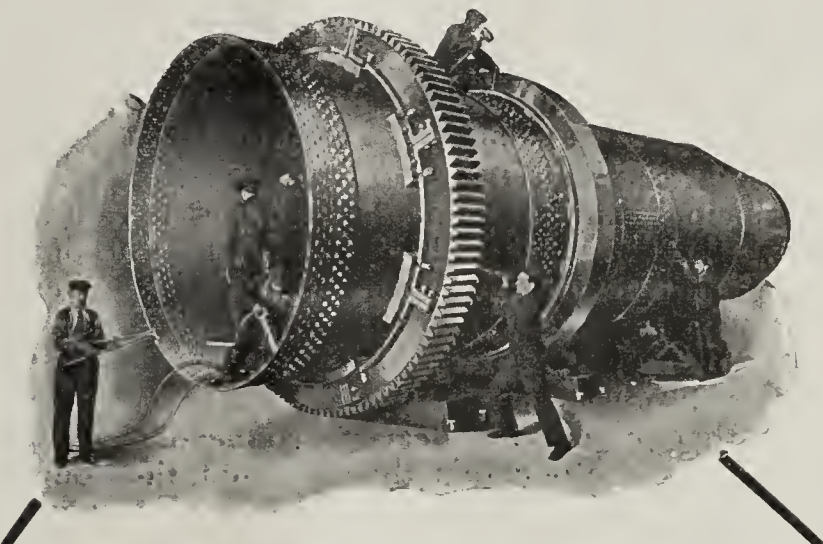
A ventilator is attached at the peak of the roof.

Strong and Self-supporting

The Jo-Be-Co roof is equipped with attachments for connecting to solid concrete, concrete block, cement stave, tile, brick and wood stave silos. See our catalog and prices.

Johnson-Bevington Co.

565 West Washington Street CHICAGO, ILL.



Building a 10 ft. x 125 ft. Two-Tire Rotary Kiln

Above is shown a section of a mammoth two-tire rotary kiln in course of construction at the VULCAN Shops.

VULCAN
Rotary Kilns

In the illustration, note the heavy, cast-steel gear, bolted to the shell in sections. The pitch diameter of this gear is 12′-8″, the pitch, 4″. Sixty-five percent of all the cement plants in the country are equipped with VULCAN Rotary Kilns

Take up your drying problems with us—no obligation. Our book on Cement Machinery sent free upon request.

VULCAN IRON WORKS
Wilkes-Barre, Pa.

Cement Mill News.

NEW CEMENT MILL READY TO OPERATE.

The International Portland Cement Company, located at Trent, 10 miles west of Spokane, Wash., whose plant has been in process of construction for some months past, will begin operations this week.

All machinery has been installed and turned over, and is found to be in perfect running condition. The process of burning will be started at once and the finished product will be ready for shipment in the next few weeks.

Approximately a million and a quarter of dollars has been spent on the plant so far for construction and working capital, and the plant will be as large as any in the northwest, having a capacity of about 1,800 barrels a day.

The mill will run night and day when operating in full, and will employ about 200 men.

Spokane Brand will be the name under which the product of the company will be known. "Spokane Brand will be of special quality, and high sand carrying capacity," said Sales Manager P. B. Beery. "This is due to the excess of impalpable powder contained in the finished product.

Explains Method.

"In making a monolith or artificial stone, or in other words, when making a high class concrete, every particle of sand and stone must be covered with a thin film of cement. The more flour or impalpable powder the cement contains the more sand and stone the cement can cover, provided care is taken to mix thoroughly.

"Spokane Brand will be wholly a home product," says the Spokane Chronicle, "the mill being located practically in the city. Ninety per cent of the employes live in Spokane, which means that an annual payroll amounting to approximately $200,000 a year comes here. The company will purchase its supplies as far as possible in Spokane.

"Principal dealers in building supplies have assured us that they would handle and push the sale of Spokane Brand. An unqualified guarantee is given by the company that every barrel they ship will pass all government and standard requirements and specifications, physical and chemical.

"Another interesting feature connected with the quality of the product is the fact that the company guarantees it to pass what is called the autoclave test. This is the most severe test that has ever yet been applied to cement and has been adopted by such railway companies as the Delaware, Lackawanna and Western. Many of the largest eastern cement producers refuse to bid on specifications containing the autoclave test."

NEBRASKA CEMENT USERS.

At the recent convention of the Nebraska Cement Users Association, held at Omaha, Neb., Peter Palmer, of Oakland, was re-elected president, and Frank Whipperman will continue as secretary-treasurer, while G. F. Lillie was the choice for vice-president. Three directors were elected to serve two-year terms. They were W. F. Neligh, of West Point; John Apple, of Red Oak, Ia., and H. R. Park, of Bruning.

The cement show held in the Auditorium, Omaha, was a great success and every one of the exhibitors was more than pleased.

ANNUAL MEETING.

At the annual meeting of the shareholders of the Peerless Portland Cement Company, of Union City, Mich., held recently, Dr. Lancaster, of Alma, was selected as president, in place of A. W. Wright, recently deceased. The other officers and directors were re-elected. The reports showed that the year just closed had been a highly successful one, and the customary dividend was declared. During the year 1912 over two thousand car loads of cement were shipped, this aggregating nearly four hundred thousand barrels. Prices are much higher than last season, and today the factory contains not more than ten thousand barrels of cement, whereas there is usually twice this amount on hand. Just at present manufacturing has ceased, and the entire factory is in the hands of repairers, who will go over every piece of machinery and put it in first-class condition for the opening of work just as soon as weather permits.

GERMAN CEMENT INDUSTRY.

The Imperial Ministry of the Interior has published data relative to the state of the German cement industry during the years 1910 and 1911. The statistics relate to the operation of 135 plants and are based on definite information furnished by 132 of them and on estimates for the remaining 3. Of the 135 plants, 117 were engaged in the production of Portland cement, 6 in the production of iron Portland cement, 6 in the production of slag cement, 2 iron Portland and slag, 1 Portland and iron Portland, and 3 in the production of all three varieties. This distribution was the same in both 1910 and 1911.

The output of Roman cement was not included in the statistics of production. The total production of all other kinds of cement in the 135 plants under consideration was 34,512,283 barrels (of 375 pounds net each) in 1910 and 39,128,216 barrels in 1911. The value of the 1910 output was $29,016,246 and that of 1911 $33,382,594. Of the total output 2,226,0 5 barrels, worth $1,903,286, in 1910, and 2,710,901 barrels, worth $2,416,414, in 1911, were iron Portland cement, slag cement, etc.

The estimated value of the raw materials used in the production of this cement was $2,815,064 and $3,213,714 in 1910 and 1911, respectively.

MANGANESE STEEL SHEAVES.

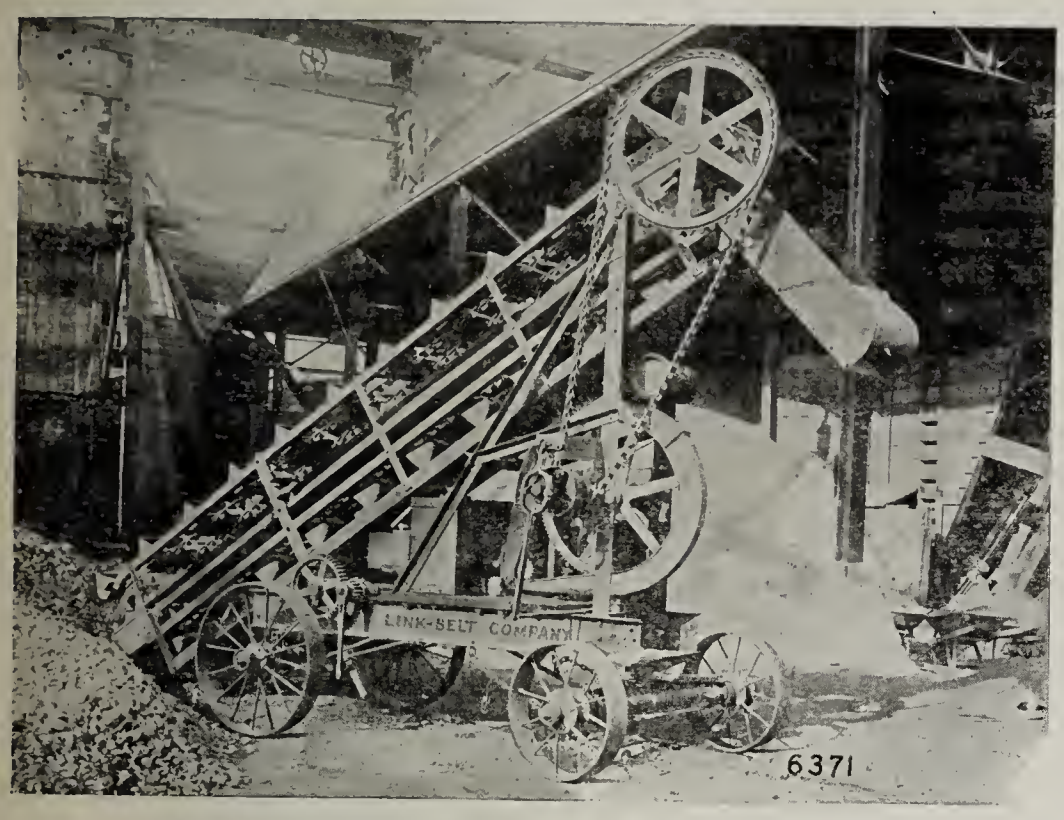
Manganese steel sheaves made of the well known "stag brand" manufactured by the Edgar Allen American Manganese Steel Co. of Chicago Heights, Illinois, form the subject of a special catalogue issued by the company.

As "stag" brand manganese steel is considered the greatest wear and shock resisting metal on the market, it is the ideal metal for sheaves, particularly for hard usage; service tests have proven it to be the most economical for the purpose.

Sheaves of "stag" brand manganese steel are practically unbreakable; they will not cut or injure the cable used on them. The grooves are smooth and the quality of the metal is such that they become highly polished in service so that the life of the cable is far greater than when used on cast iron or ordinary steel sheaves.

THE LINK-BELT STONE DIGGER

Handles Stone, Sand, Gravel, Coal, Ashes, Ore, etc.



The Link-Belt Portable Stone Digger—Crandall Company, Brooklyn, N. Y.

The quickest and cheapest method of loading material from ground storage to wagons or cars.

This Link-Belt Portable Digger

has revolutionized the method of loading—it has proved that hand-shoveling is the most expensive way to load materials.

The Link-Belt Loader

1. Handles 35 tons of stone an hour.
2. Does the work of 10 men.
3. Requires one man for operation.
4. May be moved about readily.
5. Operated by motor or engine.
6. Has long list of satisfied users.

The Loader illustrated is in daily operation at the yards of the Crandall Co., Brooklyn, N. Y., handling crushed stone and broken macadam.

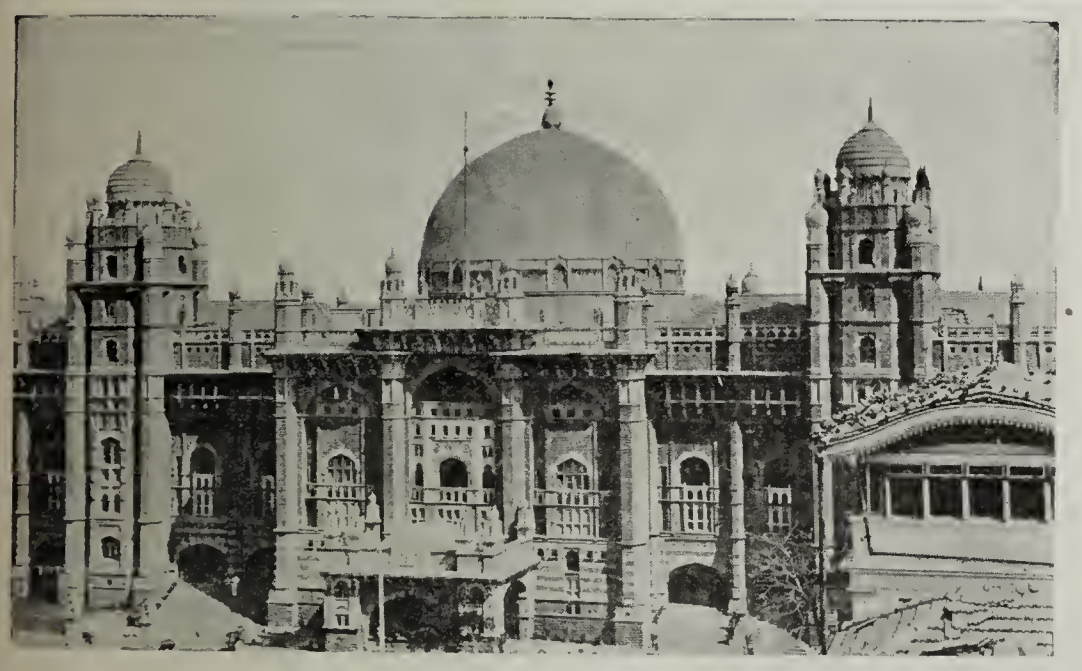
Correspondence Solicited—We invite a thorough investigation—Catalog on request—State material to be handled.

LINK-BELT COMPANY

PHILADELPHIA
New York: 299 Broadway
Pittsburgh: 1501-3 Park Bldg.
St. Louis: Central Nat'l Bank Bldg.
Buffalo: 596 Ellicott Sq.

CHICAGO
Boston: 131 State Street
San Francisco: N. D. Phelps, Sheldon Bldg.
Seattle: 512½ First Ave., S.
Denver: Lindrooth, Shubart & Co.

INDIANAPOLIS
New Orleans: Wilmot Machinery Co.
Birmingham: General Machy. Co.
Los Angeles: 204 N. Los Angeles St.
Minneapolis: Link-Belt Supply Co.



Postoffice, Bombay, India. Foundations waterproofed with Ceresit.

"Ceresit" Waterproofing

Is guaranteed as an effective, permanent water repellant for all sorts of concrete construction such as swimming pools, tunnels, foundations, reservoirs, dams, bridges, sewers, water tanks, water towers, cellars, walls, floors and roofs.

Pump pits kept dry with CERESIT

Capac, Mich., Nov. 20, 1912

Ceresit Waterproofing Co., Chicago, Ill.

Gentlemen:—

We have your letter of the 19th regarding our experience with your Ceresit,

A year ago we used a small barrel of this material with excellent results, but the test was not made until practically all of the concrete work was finished. Had we been acquainted with its excellent qualities before we probably would have used it in a large part of our work. We found, however, that in using it as an outer coat that it showed excellent waterproofing qualities and was a valuable agent in keeping the pump pits dry, which were from 10 to 20 feet deep.

Yours very truly,
Capac Paper Co., A. B. Curtiss, Gen. Mgr.

Ceresit Waterproofing is a paste which, when mixed in the gauging water, renders concrete and cement mortar impermeable to water and even dampness.

Beware of imitations claimed to be just as good. Ceresit is sold in packages labeled with our name for identification.

Please write for Booklet "Q"

Ceresit Waterproofing Co. Clark & Adams Sts., Chicago

Branches: 1133 Broadway, New York **1218 Chestnut St., Philadelphia, Pa.**

Ceresit factories are located in Chicago; Unna, Westphalia, Germany; London; Paris; Vienna; St. Petersburg

REMINDER

to write Ceresit Waterproofing Co., Clark and Adams Streets, Chicago, for Free Book "Q" on How to Effectively and Permanently Waterproofing Concrete and Cement Mortar.

Among The Cement Mills

GARY CEMENT OUTPUT UP.

Enlargement of the Buffington plant of the Universal Portland Cement Works during the last year immediately showed in the largest increase in production that the company has ever experienced in its history. The total output in 1912 was 10,114,500 barrels, an increase of over 3,000,000 barrels over 1911. The first year's production in 1900 was 62,443 barrels. President Edward M. Hager said to-day that the company had not supplied one barrel of cement for the Panama Canal on account of its location so far from the seaboard.

NEW ZEALAND PORTLAND CEMENT MILL.

A new Portland cement company was recently organized in New Zealand. It will be known as the Dominion Portland Cement Company, Ltd., with offices in Wellington, N. Z. Their capital stock is $1,250,000, all of which is already subscribed. Mr. Ernest Hunt of Wellington was appointed secretary and W. J. Wilson of Warkworth, Auckland, N. Z., late works manager of the Wilson Portland Cement Co., has been appointed works manager. The company has already purchased a large tract of land containing extensive cement rock deposits and they will erect a plant, with a view to commencing operations within 18 months.

Mr. Wilson was on a tour of the various cement mills in United States last August and while here visited with Cement & Engineering News and remarked that the only successful cement mills in New Zealand are those equipped with machinery made in the United States.

THE NEBRASKA PORTLAND CEMENT COMPANY.

At the annual meeting the other day at Superior the officers of the Nebraska Portland Cement Company, Omaha, Neb., looked over the $1,000,000 plant which is being pushed to start up about June 1, and to turn out 1,000,000 barrels annually.

E. E. Bruce was re-elected president; James Richardson, treasurer; H. G. Calkin, secretary, and these with C. E. Bedwell, C. B. Calkin, C. H. Walrath, all of Omaha, and Thomas Wolfe of David City, directors.

Stockholders formally congratulated Mr. Bruce upon the work done already and the prospects.

WILL RE-OPEN CEMENT PLANT.

At the meeting of the directors of the United States Portland Cement Company, held in Kansas City, it was decided to open the plant in Ellis county, situated at Yocemento, six miles west of Hays City, Kansas, by the middle of April. The capacity of this mill is 1,000 barrels daily. It was closed down about five months ago, as were the other mills in the state. Last year this plant was operated only a little over two months on account of the low price of cement. The raw material here is claimed to be first class. The stockholders promise to push the work vigorously and operate the plant day and night.

AMERICAN CEMENT COMPANY.

Charles J. Rhodes, treasurer of the Girard Trust Company of Philadelphia, as chairman of the reorganization committee of the American Cement Company and its subsidiaries, purchased the Reliance Cement Company, offered at auction for $50,000.

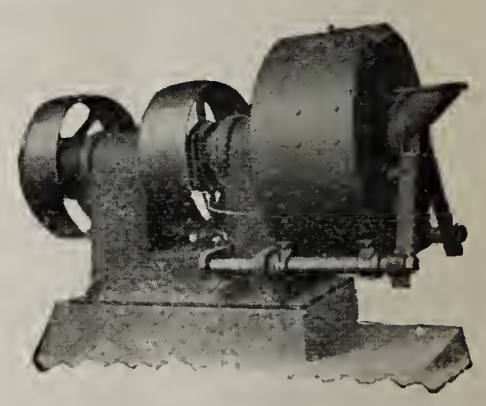
CEMENT COMPANY SUED.

Twenty thousand dollars is the amount asked by J. D. Mullaney, who has been appointed administrator of the estate of John Chirollopolous, who was killed while in the employ of the Lehigh Portland Cement Company in Mason City, Iowa. He was a young man 23 years of age. He was engaged in what is known as "topping" and his work took him into a tunnel six feet wide, eight feet high and about sixty feet long. In this tunnel ran a big belt the full distance, occupying about half the space of the tunnel. The allegation is that it was not properly lighted and the pulleys and belting were not properly protected. He was caught in the belting and killed, the accident occurring May 22 last.

CEMENT RATES UNFAIR.

The Interstate Commerce Commission, Washington, D. C., in an opinion handed down a few weeks ago, rules rates on cement in carload lots from Universal, Pa., to various destinations is unjustly discriminatory against shippers of cement from Manheim, W. Va., to the same points, and the railroads involved are ordered to pay to the Alpha Portland Cement Company of Manheim the sum of $8,685 excess charges.

Among the roads named as defendants are the Baltimore and Ohio, Bessemer and Lake Erie, Little Kanawha, Morgantown and Kingwood, Pa., Pittsburgh and Lake Erie, Pittsburgh, Chartiers and Youghiogheny, Wabash-Pittsburgh Terminal, West Side Belt and the Wheeling and Lake Erie.



Symons Disc Crushers are winning repeat orders in the largest crushing plants of the country; in well known mines in many parts of the world; where CAPACITY and DURABILITY count.

Disc Crushers follow first breakers.

Reduce the output to small sizes.

Capacity 48″ size crushing 7″ stone to 1″, 50 to 60 tons per hour.

Adjustable. Made in five sizes. Careful attention to your inquiry.

ADDRESS:

Symons Brothers Co.,

Majestic Building, Milwaukee, Wis.

Among The Cement Mills

FIRST YEAR CEMENT RECORD.

The first full year, 1912, of operation for the Inland Portland Cement Company, works at Metaline Falls, Washington, proved to be an exceedingly good one. The company shipped from the works a total of two thousand nine hundred carloads, equivalent to six hundred thousand barrels, or two million four hundred thousand sacks—without the rejection of a single pound.

"Inland" cement was shipped to every cement consuming point in the Inland Empire, and also to a number of districts in Alberta and British Columbia, in quantities from a minimum car of one hundred and thirty-two barrels to an entire trainload of twenty cars—5,000 barrels—in a single shipment.

The largest order obtained by the Inland Company during the year was the award of the contract from the Washington Water Power Company for a minimum of 150,000 barrels. The cement being furnished on this contract is used in the water power development of the Washington Water Power Company at Long Lake, Washington.

The shipments for the month of January, 1913, are approximately double the same month in the year 1912. Dan R. Brown, manager of the Inland company, states that there is every indication of unusual activity in the Inland Empire in the building and allied lines for the present year.

In anticipation of an unusually active sales and advertising campaign, the company has found it desirable to increase its space on the thirteenth floor of the Old National Bank Building, Spokane, by the addition of two rooms. The general offices of the company now occupy a suite of offices comprising seven rooms.

IRONTON CO. INCREASES CAPITAL.

For the purpose of sinking a shaft to a deposit of limestone underlying their property at Ironton, Ohio, the Ironton Portland Cement Co. have increased their capital from $300,000 to $400,000. This company looks for a prosperous year during 1913 and expresses the opinion that they will have no difficulty in marketing their entire output in the immediate vicinity of their plant.

Leschen Aerial Tramway at the Chicago Portland Cement Company's Plant, Oglesby, Ill. This Tramway spans the Vermillion River and Conveys Raw Mix to the Mill, a distance of 1,300 feet. At the present time this Tramway has a capacity of 2,000 tons daily.

Let this Machine Make the Sale

By the Quality and Quantity of Drain

Tile it will turn out right in *your own plant*

We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

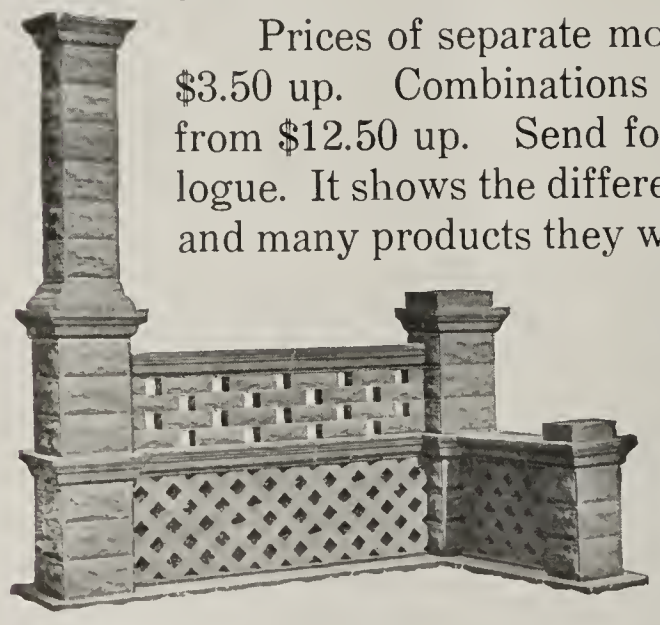
The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.

PRICE, $175

Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.



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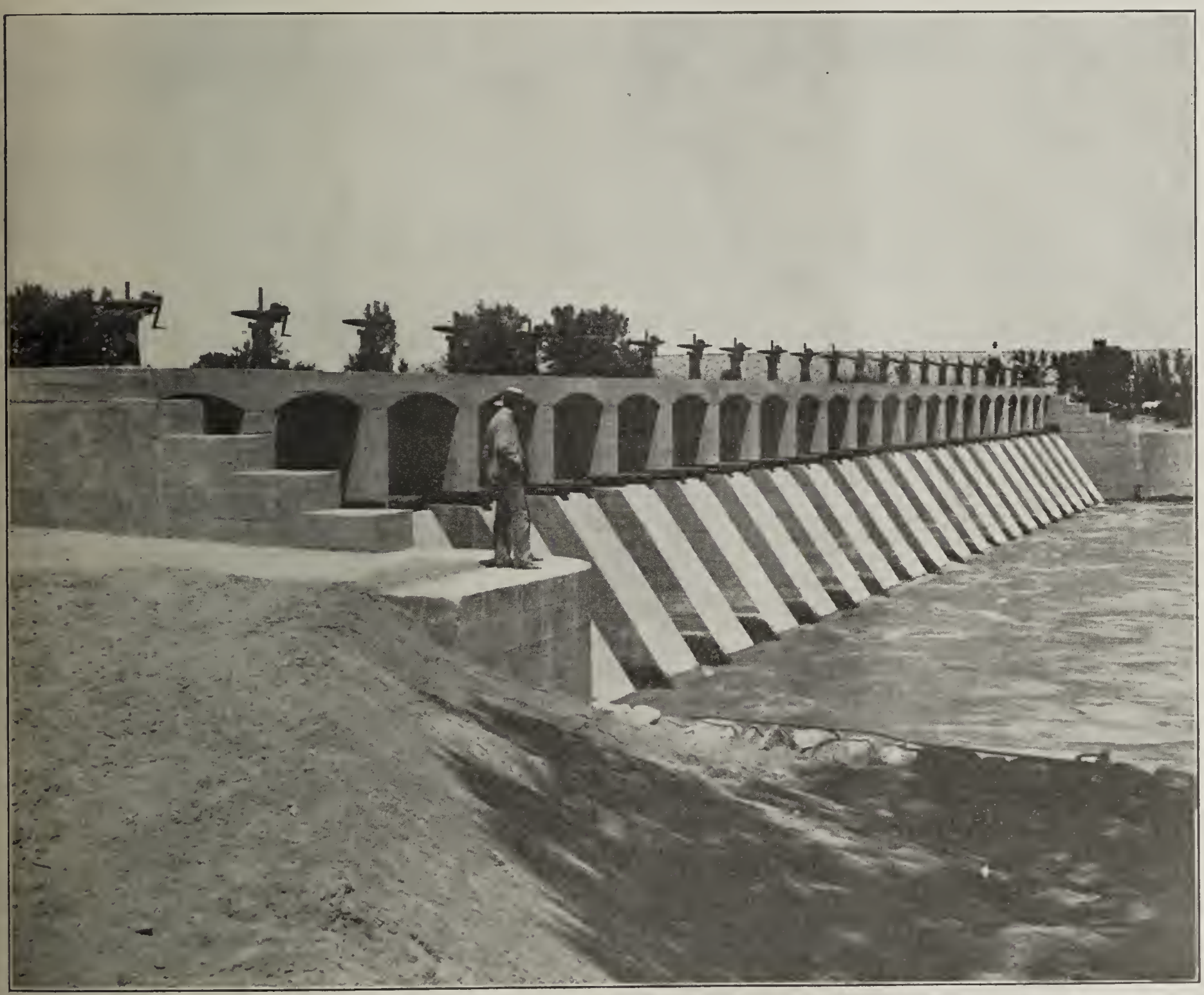

THE CARSON RIVER DIVERSION DAM CONSTRUCTED BY THE U. S. RECLAMATION SERVICE IN THE TRUCKEE-CARSON IRRIGATION PROJECT IN NEVADA.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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CHICAGO, MAY, 1913

CONCRETE ROADS

From the latest information on the subject it appears that the United States Government is about to appropriate for country roads a sum almost equal to the money spent on the construction of the Panama Canal. In addition to this, every hamlet, county and state are interested in the improvement of their roads, so that the country-wide agitation for public highways promises to lead to a system of transcontinental roads equal in value and importance to the railroads crossing the country from ocean to ocean. We are thus entering upon an era of building that can be compared only with the construction of the trans-continental railroads of half a century ago.

Up to recent times the railroads were found to be sufficient to connect the larger towns of this fast developing country, while smaller places had to get along with country roads as good as the local enthusiasm of the farmers could provide. Constant settling and filling in of the vast spaces between the large cities created gradually a demand for public highways that would enable the farmer to reach the metropolis of his district, which meant to him the artery of supply and at the same time the outlet for his products, in a more economical way than heretofore. The old-fashioned mud road, which required ten times as much labor to haul a given load, had to give away by and by to gravel or macadam roads and these are now being replaced by the more permanent concrete roads.

A study of the expenditures on country roads and of the vain efforts made in the past by counties and states to maintain the public highways belongs to the most fascinating chapter of national economy. It shows that untold fortunes have been squandered in the attempt to let the local talent take care of its special link of the long chain of roads intersecting the country. A country-wide propaganda for good roads, an educational campaign led by a competent committee and the assumption of the leadership by the Government will finally lead to the solution of the problem and will supply trans-continental concrete roads of a permanent type, which will be copied by the more isolated communities in preference to the customary gravel or macadam roads. The first outlay in money will be large, yet the saving to the farmer in hauling his products to the market will soon offset the greater expense. As a result farm products should become cheaper as the cost of transportation decreases.

An important factor in the construction of these permanent roads are the automobile interests who have done a great deal towards the development and final solution of the problem and are willing to spend large sums on the trans-continental highways, one of which is to follow the Santa Fe trail while another is to lead through the Black Hills and Yellowstone Park to the state of Washington.

As an illustration of the benefit derived from good roads we reprint the following paragraphs:

MASSACHUSETTS' EXPERIENCE IN ROAD BUILDING

Prior to 1895 the value of agricultural land in Massachusetts was gradually decreasing and we heard much of the abandoned farms of New England. In 1900 Massachusetts led all of the states in the increase of land values, and the increase began about the time that state aid in road construction became effective. This state aid was met with some skepticism and opposition, especially from the rural districts. At present there is not an abandoned farm in Massachusetts.

VIRGINIA'S EXPERIENCE

Spottsylvania county, Virginia, a few years ago bonded herself in the sum of $100,000 for good roads. Prior to that time she was anything but prosperous, but since these roads were built her agricultural and forest products have increased from 49,000 tons to 71,000 tons, or more than 45 per cent. Her shipments of high priced commodities, such as dairying and poultry, have increased from 114,815 pounds to 273,028 pounds, or over 145 per cent. Her wheat shipments have increased 59 per cent, and her tobacco 31 per cent. It is estimated that the good roads have made a saving to the farmers in the matter of transportation of $41,600 per annum, while the farms along the improved roads have shown an average increase of 33 1-3 per cent and her school attendance increased from 5 per cent to 35 per cent.

Alhambra, California, reports an increase of excess valuation of $5,000,000 and this year of $7,500,000 and attributes the increase to the building of a first class road from Alhambra to Los Angeles.

There are more than 25,000,000 farm horses and mules in the U. S., valued at $2,700,000,000; about 1,500,000 horse-drawn vehicles, valued at $83,000,000, and more than 450,000 automobiles valued at about $500,000,000. A depreciation of 5 per cent, caused by the wear and tear of bad roads, would amount to $164,000,000 annually, which at an average of $8,000 per mile would be sufficient to build over 20,000 miles of improved roads per year.

Inspection of Surface Finishes for Concrete Work

By Jerome Cochran, C. E.

Continued from page 112

Rubbed Finish.

It has been found that it is not always practicable to remove the form so soon; hence, the concrete sets up hard, and the scrubbing or brushing, as mentioned above, has little effect on it. To meet this objection, the concrete may be rubbed with a soft brick or block of concrete. These are rubbed with a circular motion. The process of rubbing consists in grinding down the surface of the concrete sufficiently to remove all impressions of the timber or other irregularities, and where but little coarse aggregate is used, or where the aggregate has been spaded back from the forms as referred to in a previous paragraph.

Preliminary Preparations.—In no case on an exposed surface of the concrete should joints of any component pieces of the forms, nor the grain of the wood, be visible. Some preliminary treatment will, therefore, be found necessary, such as chipping off rough projections, as those left by cracks in the form, filing off the arrises, etc.

Treatment by Rubbing.—The method of procedure consists in thoroughly wetting the concrete after the forms are removed, and then rubbing with a circular motion the wet surface with a coarse carborundum stone (No. 16), bringing the surface to a lather. After this stone has been used sufficiently to take off the rough projections and irregularities, the lather must be washed off with a brush and the surface again wet, and then dusted with a mixture of dry sand and cement, the proportion being 1 part Portland cement and 2 parts dry sand. This coating must be well rubbed into the surface with the coarse carborundum stone (No. 16). Care must be taken not to allow any of the mortar to remain on the surface. To give the final finish, a No. 30 carborundum stone should be used and the whole surface well rubbed.

Best results may be obtained where the concrete has not set hard, preferably a day or two old. A vigorous use of water is also advisable. In the absence of carborundum stone, a block of hard wood, sandstone, old concrete, emery or pieces of white fire brick or briquettes of one cement to one sand, made in molds about the size of a building brick, handles being pressed in while soft, may be used. By dusting on a thin-coating of cement and sand in the proportions stated above, gives a lighter surface than troweling, fills any voids that may be in the surface, and leaves the concrete more waterproof than it would be originally.

A cement wash may be substituted for the dry cement and sand, being composed of one part Portland cement to two parts of fine sand. This wash should be applied immediately after the concrete surface has been thoroughly rubbed with a piece of sandstone or carborundum stone, and the surface rubbed with a No. 16 carborundum stone and the work afterwards washed down with clean water. The grout should be used simply to fill surface imperfections and must not remain as a film on the surface. The result, after the setting of the grout, is a very smooth surface. In hot weather it should be frequently dampened for several days to prevent the small surface cracks so often seen in a finish of this kind.

Precautions.—In rubbing concrete surfaces, care must always be ta'en to avoid roughening or blunting corners of the work, and to maintain all edges sharp. Plenty of water should be used, either by dipping the sandstone or other rubbing block into the water, or by throwing the water on the wall with a whitewash brush or small broom.

Acid Wash Finish.

Applying dilute hydrochloric and sulphuric acid to concrete surfaces consists of another type of the scrubbing or brushing process described above. A desirable surface, however, may be obtained by simply brushing and washing with a hose and clean water, but the final acid treatment in connection with brushing and washing produces a still better finish, as the acid thoroughly cleans the surface of the aggregate, thereby intensifying the color and texture of same. This process is generally applied in cases where the surface has hardened to such an extent the brushing involves too great an item of work. An acid wash finish is applicable to all types of concrete work, and when the cement has been properly dissolved away from the particles of aggregate, the various shades of browns and reds of gravel may be very pleasingly brought out. The disadvantages connected with this method are the high cost and the difficulty of handling the acid to apply it and the fact that the acid that wastes and is not neutralized may penetrate the base of the structure and destroy the concrete.

Preliminary Preparations.—The concrete work should be deposited in a fairly dry mixture and care taken not to use materials which are disintegrated or affected by either sulphuric, hydrochloric or acetic acid. Sand and crushed granite give good results, but limestone generally disintegrates under the action of the acid.

Treatment by Etching.—The method of procedure consists in thoroughly scrubbing or brushing the concrete after the forms are removed, as described above for the scrubbed or brushed finish, and then washing with a diluted solution of acid applied with a brush. The acid may be applied with an ordinary calcimining brush while wet with acid the surface must be quickly worked over with an ordinary scrubbing brush and the acid immediately removed with clean water applied through a hose. After the scrubbing is completed great care must be used to remove all traces of acid, otherwise the acid will continue to etch out the cement in places and give a permanent discoloration of the surface, causing it to have a mottled, streaky appearance. The acid should not be allowed to remain on the surface for any length of time—not over half an hour—and must be thoroughly washed off with a hose and clean water. Hydrochloric acid is preferable.

Amount of Dilution.—The amount of dilution for hydrochloric and sulphuric acid should be determined by experiment as it varies with the age of the concrete. The older the concrete the stronger should the solution be. For concrete which is about two weeks old, ordinary commercial acid may be diluted with three parts of water. When but a few days old a dilution of one part acid to five or six parts of water should be used. A mixture of the two acids will produce a stronger action than the use of one alone.

A solution of one part commercial muriatic acid to tw or three parts of clean water should generally be used on surfaces in which standard Portland cement is used, and a sulphuric acid solution of the same

strength when white Portland cement and white aggregates are used in the facing mixture.

Rewashing Surfaces Composed of Selected Aggregates With Acid.—Should the surface become stained after being scrubbed and washed by placing course upon course as the wall is erected, the wall should be washed off with water played on the surface by means of a hose each night, as the day's work is completed, and after the wall is completed to the top, the whole surface should be gone over one part commercial muriatic acid and four to six parts water, the solution of muriatic acid being applied with an ordinary whitewash brush, having very little exposed metal. The acid should be left on the walls from fifteen to thirty minutes, after which it must be washed off with a hose, and in places where the stains are most noticeable, the surface should be scrubbed with an ordinary scrubbing brush.

Removal of Efflorescence.—Efflorescence, a white deposit on the surface of concrete, may be removed by using a weak solution of hydrochloric (muriatic) acid, one part of acid to six or ten of water. The wash should be well rubbed into the pores of the concrete with a brush and then rinsed off with clean water as soon as the efflorescence has disappeared. Effloresence may also be removed by the application of soap and alum washes on the surface.

Tooled Surfaces.

Concrete surfaces are sometimes picked with a pointed or toothed tool in a manner similar to that used in treating natural stone. This chips off the mortar which may have flushed to the surface, cuts away little particles of the mortar from the aggregate below. The roughening of the surface breaks up the light, gives a lighter color to the mortar itself, and, besides this, exposes the color of the aggregate below. A variety of textures of surface may thus be obtained by tooling with pneumatic tools or by hand. In other words, fine picking, chiseling or hammering either by pneumatic tools or by hand will produce differing effects, according to circumstances. This additional color on the concrete adds a great deal to its appearance. The dressing also removes most of the traces of the form and does away with irregularities which may occur in the work. While the result may be effective, tooling concrete surfaces is rather expensive and slow work and is but sparingly used. Another objection in tooling concrete surfaces comes in the removal of the surface mortar, which is the most waterproof part of the concrete. If there is any tendency toward porosity in the mass of the concrete, it will absorb more moisture after tooling than before it, and will accentuate the injury from frost. On well-made and properly proportioned concrete there

Cement Stucco Residence of Dr. T. J. Swartz, South Bend, Ind.
M. J. Knight, Contractor.

A properly constructed stucco house should need no repairs so far as the exterior is concerned for a long term of years after its erection. This is not the case unless the materials have been carefully selected and are the best obtainable of their kinds. Much of the dissatisfaction with this class of construction has been due to imperfect workmanship and improperly protected metal lath.

Galvanized lath has been used extensively for this work but has had the disadvantage of being a rather expensive material. In order to produce a cheap lath some manufacturers have resorted to cutting their lath from galvanized sheets thus producing a material having two sides of each strand unprotected and practically no better than an unprotected lath.

To meet this condition of a reasonable priced metal lath and one that would have as great a resistance to corrosion as it would be possible to secure, the Northwestern Expanded Metal Co., Chicago, placed on the market "XXth Century" expanded metal lath. This is manufactured from a special sheet which has a very high resistance to corrosion.

Three hundred and fifty yards of 24 gauge "XXth Century" lath were used on the residence illustrated on this page.

is, however, very little, if any, danger from this, as the material is of itself very dense and watertight.

This method finishing the surface cannot ordinarily be applied to gravel concrete, as the pebbles will be dislodged before being chipped.

Preliminary Preparations (Forms, Etc.).—Contrary to the practice most favorable for a scrubbed or brushed finish, the concrete must be well hardened before tooling. This does away with the need of building form work so that it may be removed in sections, as is necessary in scrubbed or brushed work. Where it is decided beforehand to tool the work, less pains need be taken in dressing the lagging of the forms. Care must be taken, however, with the forms, for unless form lumber which is uniform in thickness is employed, it becomes necessary to tool some parts of the surface deeper than others. Forms may be constructed of rough lumber, if more convenient, and the form marks and blemishes on the concrete surface removed by careful tooling.

When the concrete is to be tooled, from 30 to 60 days must elapse before the concrete is hard enough, especially where distinct edges and sharp, clean surfaces are desired.

The size of stone in the concrete should be limited to about three-quarter inch to 1 inch. Small-size aggregate will give the best results, owing to the absence of large pieces of hard material in the concrete.

Bush Hammering.—A dressed finish may be obtained by dressing the concrete surface with a pointed or toothed hammer and washing with muriatic acid diluted about one-half and carefully washed off. This must be done after the concrete has thoroughly set. Bush hammering may be used for fine detail work, finished concrete block and for imitations of natural stones. Bush hammering is the most popular method, while other forms of finish have been employed with satisfactory results.

Bush hammering may be done either by hand or with a pneumatic (or compressed air) tool. In hand hammering the concrete should be allowed to stand at least three weeks after placing, preferably longer. The concrete must not be too green, or the pick will loosen the stones and thus spot the surface with objectionable blemishes, and possibly opening up some internal cavities and starting a leak in the wall. On the other hand, the concrete should not be allowed to stand too long, for the labor will be unnecessarily great. Three months is about the limit, for concrete becomes practically as hard as the stone going to form the larger aggregate, and hand hammering has very little or no effect whatever upon the concrete.

Various weights and sizes of hammers have been used. Preference should be given to a hammer light in weight, and having but few points.

Precautions.—In tool-dressing, care must always be taken to avoid roughening or blunting corners of the work, and to maintain all edges sharp. The concrete must not be too green, or the pick will loosen the stones.

Sand Blasted Surfaces.

The exposed aggregate effect can also be obtained by what is known as the sand blast finish. The operation of impinging sand by means of compressed air against the surface of the concrete produces a finish similar to that produced by scrubbing or brushing green concrete, as described above. Sand blasting is very effective, and if carefully done by an expert, can be made to produce panels, belts, etc., and the effect of the blast can be carried as deeply as desired. It has been successfully employed in a number of important structures.

Preliminary Preparations (Forms, Etc.).—It is not necessary to construct the forms so they may be taken down in sections as required for scrubbed or brushed surfaces, for the concrete should be thoroughly hardened before sand blasting, especially if sharp edges and surfaces of a fine, uniform texture are desired.

Any pronounced ridges or irregularities in surface formed by cracks or open joints in the forms should be removed by tooling, and any pointing that may be necessary should be done several days before the surface is sand blasted.

Samples of Sand Blasting.—Samples of sand blasting should be submitted to the engineer for his approval before any sand blasting is commenced.

Treatment by Sand Blasting.—The operation of the sand-blast consists in forcing a stream of thoroughly dried silica sand, or crushed quartz, through a small nozzle by means of air pressure at 50 to 75 pounds per square inch at the nozzle. The nozzle should not be over one-quarter inch in diameter and must be held within a few inches of the surface to be cut. By a slight cutting of the surface, the appearance of sandstone is obtained. Deeper cutting will remove more of the mortar which has been flushed against the forms and the aggregate will be exposed.

Sand Blasting, Molding, Joints and Courses.—Strips nailed to the forms to make moldings, joints, and courses should be left in place while the surface is being sand blasted. Otherwise the sharp angles and edges will be rounded off in a rough and unsightly manner. The area protected by the strips should be left unfinished, unless otherwise desired.

Precautions in Sand Blasting.—Care must always be taken to avoid roughening or blunting corners of the work, and to maintain all edges sharp. The concrete must not be too green or the sand blasting will loosen the stones.

Material for Sand Blasting.—A clean, coarse, thoroughly dried silica sand or crushed quartz should be used for sand blasting, and for use with a one-quarter inch nozzle the sand should be screened through a No. 8 screen, and through a No. 12 when a one-eighth inch nozzle is used.

4. Coating Surfaces in Various Ways.

Grout Washes or Finish.—A washed or grout finish may be obtained by finishing the concrete surface with a thin mortar grout rubbed into the concrete with a float and then brushed over with a wet brush. If a non-staining cement is used for this purpose, a very good appearance can be effected which will look uniform. The chief objection to grout coatings is that they have a tendency to peel or craze. A compressed air machine may be used where there is a large amount of grouting of surfaces to be done.

Preparation of Surfaces.—All exposed surfaces must present a smooth, uniform surface of cement mortar, the concrete being well spaded, for only by thorough spading can air bubbles be worked out. The stones must be carefully but judiciously spaded away from the face; too much and unskillful spading will permit an upward flow which will wash the cement from the concrete at the face. Forks, spades, or other suitable instruments should be used for this purpose, being small enough to be pushed along all faces of the walls.

After the forms are removed, all disfigurements must be effaced, and if there are any open, porous places, they must be neatly filled with a 1:2 or 1.3 mortar before applying the wash. Any ridges due to cracks or joints in the forms should be rubbed down

smooth and hard with a float, and the rubbing continued until the marks of the forms are entirely effaced.

Washed or Grout Finish.—A washed or grout finish may be obtained by removing the forms within ten to twelve hours after the concrete has been deposited, under ordinary temperature, and finishing with a thin mortar grout, well rubbed into the concrete with either a wooden float or a piece of sacking and then brushing over with a wet plasterer's brush. The walls should be wetted with water before applying the wash.

The grout may be mixed in the proportions of one part Portland cement to one or two parts of coarse sand and should have the consistency of whitewash. A good mixture is one of Portland cement to two of fine sand mixed thin enough to be applied with a whitewash brush.

The grout may be applied in any manner, provided a uniform appearance is produced, without leaving a scale on the work. If applied with a trowel, the grout should be stiff and applied in a very thin coat and troweled or rubbed so that only the pores are filled and no body of the mortar left on the surface. Grout finishes should serve only to fill the small pits and pores in the surface coating. Care must, therefore, be taken to see that the workmen do not get a coat of the grout on similar to a skim coat of plaster, as that will generally peel in cold weather. The grout coating may also be applied to a thoroughly wet surface by throwing with considerable force by means of an ordinary whisk broom.

Grout coating or washes should be kept damp for at least a week by hanging dampened sheets close to the surface.

Coloring Grout Finishes.—The color of the finished surface will be considerably lighter if plaster of Paris is substituted for about one-quarter of the cement. Where a dark finish is desired, a grout may be made by mixing neat cement and lampblack in equal parts. One pound red iron ore to ten pounds cement mixed dry, and then made into a thin grout and applied to a well-cleaned concrete surface with a whitewash brush, gives a brick-red color; a rich dark red is given by one pound red iron ore to three pounds cement. The sooner this is applied after the concrete has set, the more likely it is to remain permanent.

Plaster of Paris Wash.—A very pleasing finish may be given by applying to the set concrete a thin wash composed of equal parts of Portland cement and plaster of Paris, though the permanence of such a wash may be open to question. The concrete surface should be cleaned from any oil or grease that may have come from the forms and the wash applied with a whitewash brush. This mixture gives a very light gray finish, and where a trifle darker shade is desired, one part of plaster of Paris to three parts Portland cement may be used.

Whitewash Finish.

Sometimes it is desired simply to whitewash a surface to secure a uniform color, though the permanence of such a wash is very questionable. Whitewash, however, when made right and properly applied, gives a coating that resists wear well and that retains its brilliancy for years.

Preparation of Surfaces.—Concrete surfaces to be whitewashed should be prepared in the same manner as that for grout washes described above.

Whitewash Finish.—The following formula for a whitewash finish has been taken from Baker's Masonry Construction, page 179, edition of 1909:

"Slack with warm water half a bushel of lime, covering it during the process to keep in the steam, and strain the liquid through a fine sieve or strainer. To the slaked lime add the following: 1 peck of salt previously well dissolved in warm water, 3 pounds of ground rice boiled to a thin paste and stirred in boiling hot water, one-half pound of powdered Spanish whiting, 1 pound of glue which has been previously dissolved over a slow fire, and 5 gallons of hot water. Stir well and let the mixture stand for a few days, covered from dirt. Strain carefully and apply hot with a brush or a spray pump. Coloring matter may be put in to make almost any shade."

Painted Surfaces.

Tinting or coloring of concrete surfaces may be obtained by the use of special coatings prepared for the market. In fact, there are on the market, sold under various proprietary trade names, a multitude of special paints and finishes for concrete surfaces, giving a wide range of color effects and also serving more or less efficiently the purpose of weather-proofing and damp-proofing. The ordinary paints, especially of the cold water variety, are usually not very satisfactory. Several special preparations, however, have proved of value.

Enamel paints may be used. Care must be taken, however, that no water or frost is allowed to get behind the enamel, otherwise it will cause the enamel to peel off.

Preparation of Surfaces for Painting.—Concrete surfaces should be free from oils, grease or other foreign matter and thoroughly cleaned and dried before painting. No surface is free from dirt and foreign matter, and it requires the removal of such substances, either by wire brushing or acid treatment, to secure a firm bond and penetrating quality to the surface. No acids should be used unless properly neutralized and washed off with water and the surface allowed to dry out thoroughly. No surface treatment or reagent is generally necessary after proper aging of the surface—six months to a year.

Concrete surfaces may be treated with a solution of zinc sulphate and water, mixed equal parts by weight, and applied with an ordinary bristle brush, after the concrete is dry. The concrete should be at least 48 hours old, preferably 72 hours, before applying the zinc sulphate solution. Concrete surfaces to receive oil paints may also be thoroughly washed with 7 to 8 per cent solution of muriatic acid and followed by a good wash of clean water. After the treated surface has thoroughly dried, the paint may be applied, using enough turpentine in the priming coat to make it almost flat and increasing the amount of oil each succeeding coat.

Printed Directions to Be Followed.—Where special preparations are used in painting concrete surfaces, care must be taken to follow closely the directions of the manufacturer of the preparation. When these paints are used the inspector must follow the printed directions for applying each.

Spraying Machines.—Compressed air spraying machines may be used for applying cold water paints to concrete surfaces. Care must be taken that the paint is applied uniformly.

Plastered Surfaces.

Plastering as a method of finishing concrete surfaces should not be employed, as it is practically impossible to apply mortar in thin layers and make it adhere for any length of time, due to differences in expansion of the materials of different composition and age. Scaling of the plaster coat is particularly noticeable in the case of walls above ground, which are subject to varying degrees of temperature. A plaster coat, however, is sometimes applied to a concrete wall to make it waterproof, as will be described in the writer's next article. The treatment of concrete surfaces

by exposing the aggregates as described above, will generally be found a cheaper and better method of securing a more pleasing surface than by plastering or by the use of a full smooth mortar surface, the mortar being a part of the body of the concrete, with the stone in the concrete worked back so as not to be exposed as described above. It is much safer to avoid plastering. It is, of course, advisable to fill with mortar any voids that may appear in the face of the work, but such places should be few and far apart.

Preparation of Surface.—In case a plaster finish is called for, the concrete surface to be plastered must be specially treated to receive the plaster coat, depending upon whether the wall is new or old. It cannot be too strongly insisted that proper precautions be taken to make the plaster stick. The best results are obtained by placing the plaster immediately after the forms have been removed and while the concrete is still green. In this case, very little or no preparation of the concrete is necessary to receive the plaster, which is applied before the wall has dried out. If the concrete wall is old, much care must be taken in preparing it for the plaster. In many cases it is well to wash or scrub the surface, or to pick it to make it rough, before applying the plaster. The surface should generally be quite rough, so as to form a clinch for the plaster. The excess of cement likely to have flushed to the surface must be removed and the surface thoroughly cleaned and well wetted before applying the plaster, or it will crack and fall off. Instead of applying the plaster finish directly to the concrete surface, the method of using a lath to support the plaster may be employed, as will now be described.

Metal Lath and Furring.—The metal lath must be of sufficient rigidity to readily take mortar when supported by furring spaced about 16 inches, center to center. The lath is generally wired to the furring angles or channels every 8 inches with No. 18 annealed galvanized steel wire, care being taken to have sufficient lap in the lathing. The lath should be tied together and also to the furring, so that there can be no settlement or sagging of the lath or the furring to which the lath is attached.

The furring should have sufficient space for the mortar to push through the mesh and clinch without interference from the backing to which the furring is attached. Furring and laths should leave an air space of at least three-quarter inch for exterior walls, it must be protected from rusting by being entirely galvanized or treated by any other equally efficient process.

Use of Nails as Furring.—At frequent intervals wire nails may be driven in the forms on the inside, so that the pointed ends project about two inches outside of the rough concrete after the forms have been removed. Before applying the plaster a small iron nut may be put on each projecting nail; the concrete work being then covered with a wire lath of 2½ meshes to the inch and No. 20 wire, and the nails bent over it with the blow of a hammer. The nuts will serve to keep the wire lath a distance of about one-quarter inch from the old concrete surface. The nails should be about 3 inches long with a bend of three-quarter inch at one end. The nuts may be either square or hexagonal, about one-quarter inch high.

Metal Lath and Wooden Furring.—Concrete walls may be provided with 1¼x3 inches thoroughly dry and seasoned, furring strips about 18 inches apart, to which may be fastened substantial metal lath and this plastered with lime mortar.

Proportioning, Mixing and Placing Plaster.—A fairly rich mortar should be used for plastering. Lime paste added to the mortar is advisable in some cases, especially for concrete building walls. This increases the adhesion and lessens the liability of cracking. If a hard surface is desired, only a small amount of the paste should be used. The mixing must be thoroughly done. The lime mortar should be mixed at least four days before using, and the cement should not be added until the mortar is ready to be used, and should be mixed in small quantities as the work progresses.

The first, or scratch, coat may be composed of one part Portland cement, three parts sand and one-half part hair putty. This hair putty should consist of long cattle hair or fibre, thoroughly worked into good lime putty. Before coating the surface the base should be thoroughly saturated with water so as to avoid suction of moisture from the covering coat, which would impair its strength and durability. Care must be taken to apply the plaster at once, and before the surface has an opportunity to dry. By throwing on plaster with considerable force, it bonds better than by spreading it. If the first coat is thrown on the second is more apt to adhere. The face of the first coat must be well scratched to make a key for the second coat, and should be thoroughly dry and surface cracks appear before the second coat is applied.

The second coat may be composed of one part Portland cement, two and one-half parts of sand and with not over five per cent lime putty and the cow-hair omitted. The scratch coat should be dampened before the second coat is applied. Before the second coat has set hard, it may be jointed to present the appearance of stone work.

The third, or finishing coat may consist of one part Portland cement to two parts of sand or screenings, with not more than five per cent of lime putty. (Crushed marble screenings may be used for the facing mortar, unless otherwise desired.) To this finishing coat may also be added pebbles or other noncombustible material as may be desired to obtain a variation in the finished appearance. Screenings or sand must not be too fine, but should be from ¼ in. diameter down. If desired, the last coat may be thrown on in order to produce a rough surface.

In all cases, one coat must follow the previous one, as soon as it has sufficiently set to allow of so doing. There should be no difficulty in causing the layers to adhere to each other, if properly applied. The concrete should be well sprinkled before the plaster is laid, as the interior concrete, being dry, will otherwise absorb moisture and prevent adhesion. Where a total thickness of not more than one inch is required, it is practicable to apply it in two coats; i. e., omitting the second coat above specified.

Joints should be allowed at intervals and made as inconspicuous as possible. Plaster should never be applied when the temperature is below freezing.

The finished surface should be protected for at least two weeks with canvas curtains or bagging saturated with water.

Thickness of Plaster Coat.—A plaster coat should either be very thin—that is, just enough to fill irregularities (as described above for grout washes)—or it should be one to three inches thick, so that it will have some strength in itself.

Splatter-Dash Finish.—An inexpensive manner of plastering is what is called a splatter-dash coat. A splatter-dash or so-called "slap-dash" finish can be secured by throwing the finishing coat unto the first or second coat, as the case may be, with a trowel from a distance of two or three feet from the work, but it takes an expert to do good work in this manner. A rough surface is generally better in appearance and less liable to crack than a smooth surface.

Pebble-Dash Finish.—A pebble-dash finish may be

made by throwing on mortar and leaving it regular but rough. The cement and lime paste should be mixed to the consistency of thick cream and washed pebbles added in the proportion of five parts plaster to one part pebbles by volume.

Pebble-Dash Finish (Alternate Method).—A pebble-dash surface may also be obtained by applying the finishing coat of plaster fairly wet and then throwing clean pebbles into the fresh plaster. The pebbles should be about ½ in. in diameter and should run uniformly. The pebbles must be wet just before throwing them on the fresh plaster. The work should be started at the top and the pebbles thrown with a sweeping motion such as is used in sowing seed. The pebbles must be distributed uniformly over the surface and must be thrown with sufficient force to embed them securely. Care must be taken not to disturb the cement after it has started to set, and in order to avoid this, the surface must be covered with the pebbles immediately after the fresh plaster is applied. Particular care must also be taken to make the whole surface continuous; that is, one patch of plaster must not be allowed to dry before the adjoining space is covered. This is a simple and inexpensive, yet thoroughly practical method of securing an artistic effect.

5. Other Methods of Exterior Finish.

Cut-Stone Finish.—Strips of wood may be nailed into the forms to give the effect of cut stone to the surface when the forms are removed.

Clapboard Finish.—Exterior forms may be arranged by letting the outside boards one inch thick lap over each other, the exposed width being about ten inches, to give the effect of clapboard finish. The concrete may be left as it comes from the forms, no rubbing whatever being required.

Panel Finish.—A board surface may be relieved of its monotony by paneling. The larger and rougher the surface the bolder the panels should be. Long retaining walls should preferably have panels to relieve the dead flat surface.

Inserted Patterns (Colored Clay Tile, Etc.).—More satisfactory methods of securing colored surfaces are by the employment of colored clay, colored tile or mosaics embedded in the concrete. Colored tile has been used with marked success. There are several methods by which these clays can be inserted in the concrete.

Tile may be first glued to perforated forms with common bill posters' paste, and the mass concrete deposited as usual. When the concrete has properly set, wetting the forms with water will dissolve the paste so as to allow the removal of the forms. Before the forms are removed they must be thoroughly flushed with water. Such tile work can also be slabbed in sections at the pottery, and the slabs transported and nailed to the forms, the mass concrete being deposited as usual. Copper tacks are sometimes used to secure the slabbed tile to the forms or centering, no discoloration from rust taking place with the lapse of time where copper tacks have been used. A piece of felt should be placed between the form and the face of the mosaic, if such be used, in order to prevent the smaller particles of grout from running on to the

Cement Stucco Residence of Mr. L. W. Hubbard, Kalamazoo, Mich.
General Contractor, Guy Remyuse.

Stucco construction is applicable to any style of house, though one is often led to think that it is only being used in the low rambling style of bungalow or cottage, because of the numerous illustrations of this type that are seen in connection with the many articles in the magazines describing stucco houses. The Kalamazoo home illustrated on this page shows the application of stucco to the popular square shaped house. While the design of the house itself is all that could be desired, the general appearance would be enhanced by a judicious use of trees and shrubbery.

We have mentioned in a previous issue the increasing number of artistic homes that are to be found in some of the smaller cities. Since that time we have had opportunity to see a number of residences in the smaller cities of Illinois and Indiana which are not excelled by any in the exclusive suburban residence districts of Chicago and New York. All of these are designed along lines which could well be followed by our metropolitan architects.

300 square yards of XX CENTURY expanded metal lath manufactured by Northwestern Expanded Metal Co., Chicago, were used for the stucco construction on Mr. Hubbard's residence.

face of the mosaic and staining it. The prepared ornamental slab is then backed up and surrounded by a firm body of concrete.

Another method of inserting tile or pattern work is to place them piece by piece in the wall after the removal of the forms, in which case sunken panels from 1 in. to 1½ ins. deep, of an outline to suit the design, should be provided for their reception. These panels are then filled in at any convenient time with the tiles bedded in cement mortar. In providing space into which to set tiles, pieces of wood of the exact size of each tile or tile work slabbed in sections, should be nailed lightly to the forms, so that the forms can be removed without pulling them from the concrete. When the forms are removed, these pieces of board will remain in the surface of the concrete, and should be left in until whatever surface finish desired for the remainder of the work has been completed. They are then removed, thus leaving recesses, conforming to the design, and the tiles or ornamental slabs are placed in these recesses, being cemented in with a mortar, varying in color to conform with the design. Belt courses around columns or along facades, ornamental medallions and innumerable other points have been beautifully ornamented by this means.

Brick Veneering or Facework.—When concrete is to be faced with brick work, care must be taken to imbed a sufficient number of metal ties for tying the face brick work to the concrete. One tie should be used for about every two square feet of surface, except in earthquake countries, where there should be one every square foot. Wire ties should be at least ⅛ in. in diameter, with one end bent. One end of the tie should be thrust through a small hole in the forms immediately after the concrete is placed and before it has set. Upon the removal of forms, the projecting end of the tie should be bent at right angles and imbedded in the mortar between the bricks.

In laying brick masonry every brick must be cleaned and thoroughly saturated with water, and should be laid in the best hydraulic cement mortar, with such thickness of joint and style of bond as prescribed by the engineer or shown on plans. No broken bricks should be used in the face of any wall, except when necessary to make closures for properly dimensioning the several courses or to break joints.

Stone Facing.—If stone facing is used for concrete work, the stones should be of an approved quality. The stone must be of a compact texture, free from loose seams, flaws, discolorations or imperfections of any kind, and of such a character as will stand the action of the weather. The stone facing should in all cases be securely bonded or clamped to the concrete backing. All stones should be dressed to true beds and vertical joints, unless otherwise desired. No joints should exceed ½ in. in thickness and should be laid to break joints at least 9 ins. with the course below. All joints should be cleaned, wet and neatly pointed. The facing stones should be in true line, and to the dimensions given on plans. All cornices, moldings, capitals, keystones, brackets, etc., should be built into the work in the proper positions, etc., and should be of the forms and dimensions shown on plans.

METAL LATH SILOS.

The above is the title of a little booklet which the Northwestern Expanded Metal Company, of Chicago, have recently issued. The matter contained in this booklet was reprinted from Cement Silo Construction, as published by the extension department of the Kansas State Agricultural College. It is a detailed description of the method of construction of a metal lath cement silo.

The foundation, the inside scaffold, the construction of the form for door opening, the erecting of the 2x4 studding, the placing of gas pipe in door form, placing of metal lath, extra wire reinforcement, closing door form on inside, placing bolts to hold the plate to the wall, placing bolts to hold the chute, the inside and outside plastering and construction of roof are all fully dealt with in a thoroughly understandable manner.

Particularly interesting is that section describing the placing of the metal lath. "The twenty-four gauge expanded metal or metal lath is used in the construction of this silo. It comes in bundles, each bundle usually containing nine strips, eight feet long and eighteen inches wide. A bundle of this size contains twelve square yards and weighs forty and one-half pounds. This metal lath is tacked to the inside of the studding with double-pointed tacks. The work of placing it should begin at the top, starting at the door post. The end of the first strip should be passed through the opening in the side of the door box and bent around the gas pipe already in place. Each strip of lath should be tacked first in the middle; the workman should go from that place toward the end, and should, as the tacks are driven, push out the lath so that it naturally takes the form of the circle. The end of the second piece should be lapped at least three inches on the piece already placed. So continue until the gas pipe on the other side of the door is reached.

"Where the ends of the lath pass the hooks of the rods across the door, it will be necessary to split the end back about four inches, so that it can be bent around the gas pipe properly. It is very important that the end passing around the gas pipe be long enough to encircle it completely. Two workmen are needed to do this work to good advantage, and more men can be used if they are available. The different rounds of the lath should lap from a quarter to a half inch, and in case any bagging is seen the edges must be wired together with light wire. This will prevent a great deal of annoyance to the plasterers in placing the first coat of plaster. Whenever it becomes necessary to splice the ends between studding, the splices must be carefully wired together. When the ends are spliced on the studding and lapped three inches, this wiring is not necessary. This expanded metal lath has a right and wrong side, and the best results are secured if the material is so placed that the slant of the mesh is downward when looked at from the inside. If, when the bottom is reached, the lath does not come out even, which is usually the case, the last round may be left full width in case there is enough lath to allow this. Care taken in getting this lath smoothly placed and carefully wired will mean the saving of money later, since the plasterers can make better headway where this work has been properly done.

By writing to the Northwestern Expanded Metal Co., Old Colony Bldg., Chicago, and mentioning Cement and Engineering News, you can secure a copy of this Metal Lath Silos booklet.

Mr. Richard K. Meade, the well known cement and lime expert, announces that he has opened offices and laboratories at 202 North Calvert St., Baltimore, Md. Mr. Meade will make a specialty of the design and construction of lime and cement plants and of reports on lime and cement propositions and properties. He is also prepared to make tests and analyses of lime and cement and to advise manufacturers relative to the improvement of their plants, process or products.

Preventing Settlement Cracks in Stucco Houses

Common Method of Framing Each Story Separately—How to Minimise Effects of Settlement and Shrinkage—Use of Crimped Metal Furring.

By Ernest McCullough

The concrete contractor is often called upon to do work that encroaches upon that of plasterers in the building of stucco houses, and much trouble is experienced with cracks caused by contraction and expanion of the frame of the building. A builder recently asked an opinion of the writer and gave the following data: "I am doing a great deal of building now for people who want stucco houses, but all the houses I have seen with stucco on the outside are badly cracked and I want to know if a frame house can be covered with stucco without having the stucco crack?

"In this section we frame all our stories separate and set out studding 16-in. center to center. We sheathe the exterior diagonally with boards one inch thick, allowing about an inch shrinkage joint all around the building opposite each floor level.

"On top of these boards we nail strips 1 in. wide by ½ in. thick in the form of squares about 12 in. each way, on top of which we nail our metal lathing. We then plaster the lath with cement mortar in three coats, to about ¾ in. in thickness. The work is well done, but is not satisfactory, for when the lumber shrinks the plaster cracks and the building looks badly."

The writer has noticed a number of buildings where the work was done in this manner and is not surprised to hear that results are not always satisfactory. The common method used for framing each story separately is to first lay a plate and on this plate rest the joists for the first floor; on top of the joists a sill is laid and the ends of the studding rest on this sill. On top of the studding is a plate, or cap ,and on top

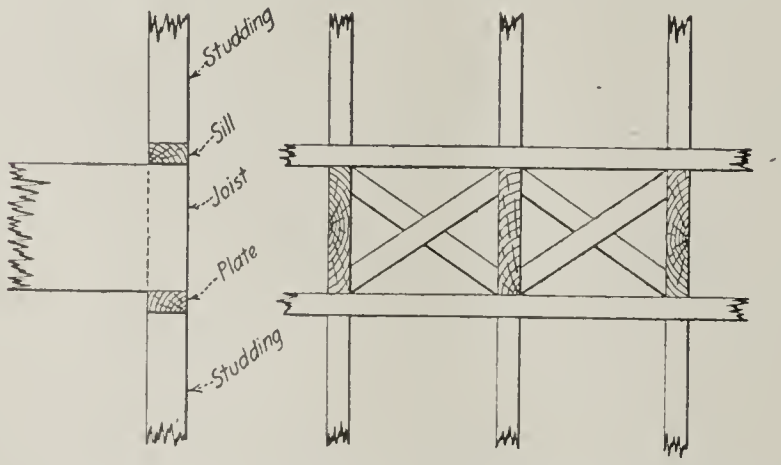


FIG. 1. SIDE AND END VIEWS SHOWING OLD METHOD OF CONSTRUCTION FOR FRAME HOUSES.

of this the ends of the joists for the next floor rest. To carry up the next story a sill is laid on the joists to carry the studding, etc.

Wood does not shrink edgeways to any appreciable degree, but it does shrink sideways by the drying out of the hollow fibers of which the wood is composed. In the method of construction just described there is a plate with some space underneath, and there is a small space between the joists and the plate, with a third space between the tops of the joists and the sill and a fourth space between the lower end of the studding standing on the sill. Thus at each floor level there are four small spaces, the size depending entirely upon the accuracy with which the carpenter makes his cuts and affected considerably by the roughness of the surfaces in contact. When the building is completed and the floors are loaded some settlement must occur. Plates and sills are generally two inches thick and between them the floor joists are usually ten inches deep. This gives at each floor level 14 inches in which shrinkage can take place and cause some movement in the

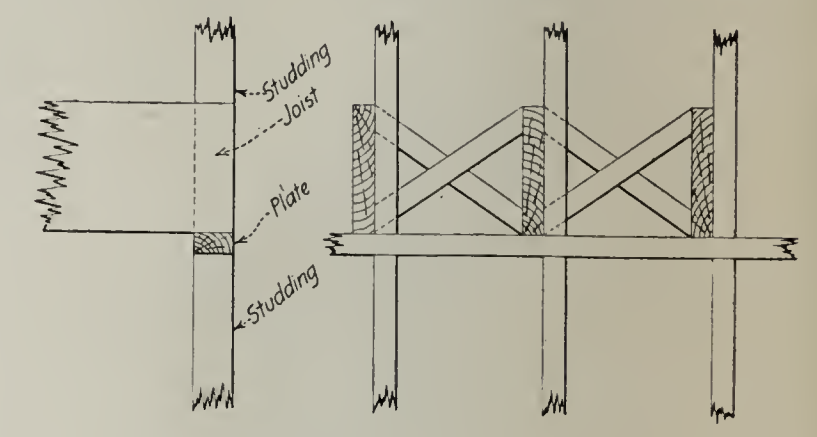


FIG. 2. MODERN METHOD OF CONSTRUCTION FOR FRAME HOUSES. SCALE, ½ IN. TO THE FOOT.

framing, in addition to the movement caused by the joints closing up.

To minimize the effects of settlement and shrinkage the buildings should be framed differently. The lower plate should be surfaced and the studding should rest upon it, the joists being placed on the plate beside the studding, instead of under the ends. A sill on top of the joists is then unnecessary and instead of having 14 inches of material with four joints there will be only two inches of material with two joints, and as the plate is surfaced, a little care in cutting the ends of the studding perfectly square will reduce the size of each joint. The second story should be framed the same way, a cap being placed on top of the lower studding, on which will rest the studding for the upper floor, the joists also resting on this cap, but beside and not under the upper story studding.

The sheathing should be placed horizontally and not diagonally. (See page 644 of *The Building Age* for December, 1912.) This sheathing is used to carry a lining of paper to make the building tight and should be used for this purpose, without attempting to make it a diagonal bracing for the frame. Diagonal bracing is best made by gaining a 1-in. x 4-in. into the studding or by setting in bridging which can be utilized as a fire stop by putting on a few inches of mortar. Leaving openings for shrinkage at each floor level is not necessary when the boards are placed horizontally, but if no provision is made for settlement and shrinkage at the floor levels it is best made by a method to be described. If the sheathing is placed diagonally it will be impossible to fasten the furring properly.

Boards become narrow when they shrink and when nailed through the center the shrinkage will have a tendency to open the spaces between the boards, the

position of the boards remaining unaltered because of the nails in the middle. . That this action takes place is shown by the fact that boards used for sheathing with nails driven near the edges, usually crack where the nails are driven. Placing wood lath on the sheathing in small squares makes it a foregone conclusion the shrinkage will affect the plaster. The horizontal strips should be omitted and the vertical strips should be nailed only through the middle of each board, or long nails should be used and the furring strips attached to the studding direct, through the spaces between the boards. When nailed through the middle of the board only, the strips will not move when the boards shrink in from the sides. All danger of movement on the part of the furring strips is removed when they are fastened directly to the studding, for the sheathing boards are then free to move.

The writer does not recommend the use of wood furring strips, for they swell in damp weather and contract in hot weather, with bad effects upon the plastering. Metal furring strips alone should be used and crimped metal furring is sold by nearly all dealers in building materials. Crimped furring is flat wire or band iron crimped for stiffness. It is set on edge and staples driven through the metal lath hold the furring in place. Crimped furring comes in the following widths: ¼-in., ½-in., ¾-in., and 1-in. The ¼-in. weighs 1/20 of a pound per foot, 50 lbs. being required when set on 12-in. centers and 37 lbs. being required when set on 16-in. centers, for 100 sq. yds. of metal lath. The ½-in. width weighs 1/18-lb. per lineal ft. and 40 lbs. are required when set on 12-in. centers and 34 lbs. when set on 16-in. centers. The ¾-in. furring weighs 1/15 lbs. per ft. and 67 lbs. are required for 12-in. centers and 45 lbs. required for 16-in. centers. The 1-in. furring weighs 1/10 lb. per lineal ft. and 90 lbs. are required for 12-in. centers and 67 lbs.

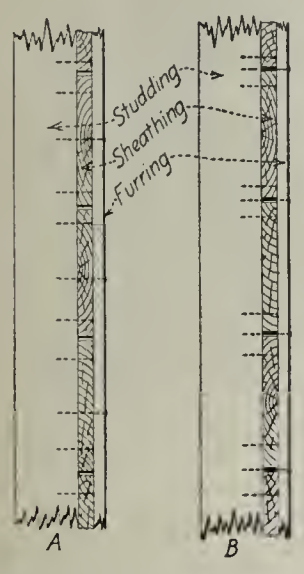


FIG. 3. TWO APPROVED METHODS FOR NAILING FURRING OVER SHEATHING. SCALE, ¾ IN. TO THE FOOT.

for 16-in. centers. The staples for above work are from 1 to 2½ ins. long and the following quantities are required when furring is set on 16-in. centers: 1 in. long, 10 lbs.; 1¼ ins. long, 12½ lbs.; 1½ ins. long, 15 lbs.; 2 ins. long, 40 lbs.; 2½ ins. long, 50 lbs., for 100 yds. of metal lath.

The use of crimped metal furring does away with the one-inch width of plaster that rests upon wood furring strips and thus no lines show in damp weather. It makes the plastering more solid and the width of the furring to use depends upon the thickness of finish wanted, there being an air space between the plaster back of the lath and the sheathing, the air space being nearly ¾ in. with the 1-in. furring and being practically non-existent with ¼-in. furring. The furring is fastened at the time the lath is applied, the staple going through the lath and on each side of the metal furring, thus saving some labor cost and nails, for staples must be used with metal lath even when wood furring is used, which must be held in place with nails.

The practical man can readily see that when a building is so framed that half the joints are done away with and all shrinkage is carried in one narrow piece, instead of two narrow pieces and one wide piece at each

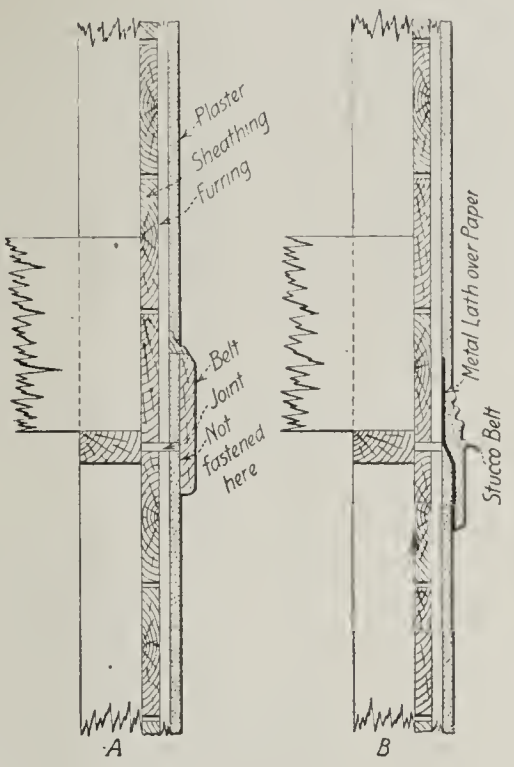


FIG. 4. JOINTS AT FLOOR LEVELS OF STUCCO HOUSES.

floor, much of the trouble causing stucco to crack is done away with. By fastening the furring in the portion of the boards where no movement occurs when the boards shrink, or by fastening to the studding by nailing between the boards, a further cause of cracking is removed. By using metal furring the damage caused by moisture in wood furring is done away with and the metal furring is held by staples in such a way that some slight movement can take place without affecting the plaster. When all of the precautions mentioned have been taken everything is done that can be done to stop the cracking which is caused by movement in the framing and sheathing.

The term stucco was originally applied to exterior plaster containing plaster of paris, or gypsum. Today the term stucco applies to all exterior plastering work and few plasterers use any gypsum or lime, for cement mortar is the only material that should be used for exterior work. Cement mortar works rather stiffly under the trowel and plasterers do not like to use it. It can be made to work smoothly by retempering, or by adding not more than 5 per cent hydrated lime, the use of lime being a concession to the feelings of the man applying the plaster; for while he can do a better piece of work without the lime he cannot put on as many yards in a day as when lime is not used.

In spite of all the care used cracks will sometimes appear that are caused by a settlement at floor levels and when the building design permits, a joint can be left around the building at the level of each floor. This joint is made by stopping the furring and lath, leaving a space of nearly one inch between the upper edge of the lath on the lower story and the lower edge of the lath on the upper story. The plastering is done in the usual way and this joint is filled with lime mortar. To conceal the joint a belt of wood is placed around the building, being attached to the upper floor and lapping over the joint on the lower story about an inch, with-

* *The Building Age.*

out being nailed on the lower edge. The writer saw one very neat piece of work where the belt was made by plastering the lower story and letting the lath from the upper story lap over it, a sheet of smooth paper being placed under the lath so that when it was plastered upon, the plaster did not adhere to that on the lower floor and a slip-joint was formed.

Since the introduction of I-beams and channels made of very light metal a number of houses have been built with metal instead of wood framing, metal lath being attached directly to the frame. In such houses no cracking can occur because of shrinkage or settlement, if the sections are not too light to carry the loads imposed. Such houses are fireproof, vermin-proof, cool in summer and warm in winter, the cost being very little more than the cost of a frame house in many localities, while in some places such buildings are actually cheaper than a well constructed wood frame building. Unfortunately architects have not as yet viewed the matter with much favor and nearly all

PREVENTING SETTLEMENT CRACKS IN STUCCO HOUSES.

houses built in this way have been designed by the engineers of the companies selling the material, the total absence of architectural beauty being a marked feature. The building herewith shown was constructed with all the framing of metal lumber, even to the floor and roof joists, the picture being reproduced from a photograph kindly loaned to the writer by the Northwestern Expanded Metal Company, this company furnishing the metal lath and the Berger Manufacturing Company the metal lumber.

While the house illustrated in the last picture in connection with this article may not appear attractive to many readers because of its exceedingly plain outlines, yet in reality it looks much better than one would suppose. The cost was about 5 per cent less than that of a brick veneer building erected from the same drawings; that is, bids were taken for the building constructed of brick and also of brick veneer for purposes of comparison. The only wood in the house as it stands are the window frames, sash, doors and the floors, the latter being covered with wood carpet.

The building was erected precisely as a wooden frame structure would be built with studding and joists. The difference between it and a wooden building is that the studding is of light steel and the joists are Berger metal lumber. The floors are of reinforced concrete and the walls and ceilings are plastered with cement mortar on expanded metal lath. On this building there need be no insurance and the contents carry the very lowest rate. In its erection the blacksmith's shears and the tinner's snips took the place of the carpenter's saw, while wire took the place of nails and pliers supplanted hammers.

SAND AND CEMENT TO BE USED IN BIG DAM.

The reclamation service is installing a plant for the blending of sand and cement at Arrowrock, Idaho. This plant will have a daily output of 1,000 barrels of 40 per cent blend sand cement and will cost approximately $40,000. The product will be utilized in the construction of the Arrowrock dam, which is to be the highest masonry dam in the world.

This enormous structure, which will be 351 feet in height, will require 500,000 barrels of cement, and the engineers estimate that the use of the blended sand and cement will effect a saving of more than $250,000 in the cost of the dam. Experiments in the dilution of cement with extremely fine ground silica, notably on the Los Angeles aqueduct, have shown that great economy can be affected in concrete construction. On the aqueduct work the cement is being reground with volcanic rock, the latter comprising from 60 to 70 per cent of the whole. This mixture is being used in the usual way in making concrete and is standing all the tests as to strength and other qualities.

At the Arrowrock site there is an abundance of granite, which will make a first-class blending material, the use of which it is believed will result in great saving in the cost of cement. This is not the first experiment in manufacturing by the Reclamation Service.

Some Remarks on the Depreciation Factor in the Cost of Producing Portland Cement.

By Frederick H. Lewis, Birmingham, Ala.*

At the moment the question of the depreciation factor in the cost of producing portland cement is commercial rather than technical. Its urgent importance as a business proposition overshadows its scientific interest. The manufacturers of cement have so notably failed to define the cost of production, that few of them have a surplus or depreciation fund of any kind to deal with. In recent years numerous plants have yielded returns little if any greater than bare factory cost, and the commercial rating of the industry as a whole has suffered. The value which a technical discussion of depreciation may have, therefore, will consist chiefly in defining for the commercial end of the business the elements which should be considered to make up a satisfactory price for a barrel of cement.

The portland cement industry in America is but thirty-seven years old. The first factory was built at Coplay, Pa., in 1875. This plant grew to considerable size and importance during the twenty-five years ending in 1900. But during the latter part of this period units of considerable size were one by one discarded as having reached the limit of their useful life. The early developments of the American, Atlas, Alpha and Lawrence companies were similarly discarded. It is the writer's judgment, based on personal observation only, that the average useful life of plant units discarded in this way did not exceed ten years, and that it must have required 15 to 20 cents per barrel to cover the depreciation factor. Fortunately at that time prices carried an adequate margin of profit.

It is quite likely that present plant is more nearly standardized and that it may suffer less from obsolescence. But this is not certain; and the simple fact is that we have no sufficient experience to justify this conclusion. The development of production has been so rapid during the seventeen years just past, that if we assume increased output to be directly represented by the new plant (which is not strictly true), then we shall find that the average age of the plant units which will produce this year's output is seven years. We have then no sufficient industrial history to establish our data. We are forced to exercise our best judgment.

Fifteen years ago an English manufacturer stated to the writer that the repair cost in the manufacture of cement would average six pence per barrel (12 cents). Subsequent experience verified this to be a reliable estimate. Today the figure is probably nearer fifteen cents because the mechanical equipment has been much elaborated in recent years. If it is assumed that the necessary capital required is $1.50 per barrel of annual output, then the ordinary repairs in the manufacture of cement amount each year to ten per cent of the entire investment. This is not depreciation; it has nothing directly to do with depreciation. It is ordinary repairs. Depreciation "is the necessary annual installment of the annuity which will amount to the first cost of the property at the expiration of its useful life." The cost of ordinary repairs is merely the first factor to be considered in estimating the useful life of the plant. The high cost of repairs indicates rapid depreciation, or a short useful life.

*Read before The American Society of Mechanical Engineers.

The second factor to be considered is obsolescence —that form of depreciation due to improvements in methods or in machines which makes it necessary to modify plant and scrap machinery which is still in good running order. As already indicated we have little data in regard to this. It may be accepted as definitely true, however, that few plants could be successfully operated today with the equipment and arrangement they had ten years ago. The very few which might make such a claim, can do so only because either by chance, or by reason of greater foresight, they happened to be designed along the lines which later progress has followed. Plants which are now ten years old or more and which are still operated, have generally had large expenditures put into them for enlargements and for improvements in details; and in spite of this are operating at some disadvantage by reason of obsolete machinery. Kilns and power plants in particular have changed notably in design, and the economy of heavier machinery, and of labor-saving equipment has continually claimed recognition. Enlargements and modifications of plant have more often been forced upon manufacturers than desired by them. Enlargements beyond a certain point is no longer desirable, but has frequently been accepted as the only alternative to closing down the plant. Such forced enlargements represent, therefore, in considerable part, depreciation pure and simple, the gradual replacement of an obsolete plant which will be as gradually discarded. Yet the cost has in most cases been paid for out of new capital. The writer has not sufficient data to be able to express an opinion on the cost due to obsolescence during the period from 1900 to January 1, 1912. No one familiar with the facts will doubt that it has been large.

A third factor to be considerel in estimating depreciation is loss of profits due to shutdowns for repairs and renewals. This is often a considerable sum, by reason of repair periods extending over three, four, or even six months. If there is no surplus fund to carry interest and overhead charges during such periods, then the business has not fully provided for the expenses due to depreciation.

There are then three principal factors to be considered in estimating a depreciation factor: (a) wear and tear; (b) obsolescence; and (c) the carrying charges during repairs.

The ordinary procedure of cement plants is to limit their cost data to a monthly cost sheet. This deals simply with factory cost and usually, and quite properly, with only a part of the factory cost. The real and only useful purpose of these monthly cost sheets is to enable operating officers to institute comparisons, locate leaks, and cut down regular operating cost items. Unfortunately, and quite generally, the cement people have made the serious commercial blunder of regarding these factory cost sheets as really representing the cost to be kept in view when making prices. An immense industry has been rendered unremunerative for five years past by this unfortunate blunder.

A factory cost sheet to be useful for comparison of cost items from month to month and from year to year, should exclude all occasional or extraordinary expenditures. If items of this character were intro-

duced at random as they occurred, the value of the cost sheet would be destroyed. Such occasional or extraordinary expenditures, which are really depreciation charges, must be provided for annually by appropriating a sum for plant renewals to be accounted for separately from the cost sheet. This appropriation can be an arbitrary one, or may vary from time to time as the superintendent's report may indicate the renewal requirements.

It is to be remarked here that it is usual to deal with depreciation as an annuity payment at compound interest. The propriety of figuring the annuity at compound interest for cement plants is open to question. A cement plant is not at all like the one horse shay which went to pieces all at once, and nothing first. On the contrary there must be a considerable annual depreciation fund for immediate use, and which can have no interest accumulation. Not to gainsay an accepted method, depreciation should be provided for in two items: (a) an annual plant renewal charge, and (b) a depreciation charge. The accounts of the United States Steel Corporation follow this method. There is a regular depreciation fund which is three per cent of gross earnings, and a construction or plant renewal fund of an approximately equal amount, but which varies more or less as earnings vary.

Coming then to a method of figuring depreciation, let us make the following assumption:

a Net capital investment = $1.50 per barrel of annual output, or 1.5 cents per barrel = 1 per cent return on the capital.

b True depreciation to be based upon twenty-five years' useful life at 4 per cent compound interest. This equals 2.4 per cent per annum or 3.6 cents per barrel of cement.

c Plant renewal to be based on twenty-five years' useful life, but without interest accumulation. This equals 4 per cent per annum, or 6 cents per barrel of cement.

This basis assumes that each of the several items of the plant will be renewed once in twenty-five years, and that at the end of this period of twenty-five years the entire plant will have reached the end of its useful life. The writer is prepared to agree that this basis is low. But if the general argument is good, then the figures may be modified by exchange of views and data.

Assuming a factory cost of 60 cents per barrel, a remunerative selling price would then be estimated about as follows:

	Cts. Per Bbl.
(a) Factory cost including all ordinary repairs	60.0
(b) Depreciation fund	3.6
(c) Plant renewal fund	6.0
(d) Administration and selling expense, say	10.0
(e) Interest at 6 per cent on investment	9.0
Selling price	88.6

It will require about 90 cents per barrel to come out even in this assumed case. It will require a higher average price if the business is to have a credit balance outside of depreciation.

On some such basis as this any manufacturer can estimate a safe selling price, using the actual facts of his own books for capitalization, factory cost, administration and selling expense, etc. If this is done most manufacturers will find that current prices have been too low in recent years, and still are so; many will find that an excessive capitalization must be scaled down if the business is to continue. And some will find themselves facing conditions which will make it impossible to continue the industry.

"YOU CAN'T GO WRONG WHEN YOU CHOOSE THE UNIVERSAL CRUSHER."

These remarks were made by one of our leading contractors in the middle West, and the following statement is absolutely the truth:

When a contractor is in need of a stone crusher to utilize waste materials or to prepare his aggregates for construction work or for material used in the construction of highways and roads, the Universal crusher has proven a machine to do such work in a more economical way than with older and more well-known types of crushers in general.

One of the main reasons why the Universal crusher is more profitable is because it is light in weight and can be easily moved from place to place, and requires less power for producing the same amount of crushed rock; its wide range of adjustment by which any size of material can be produced. This adjustment can be made without stopping the machine for an instant or without changing any parts or without the use of any tools whatever.

All parts in the Universal crusher are made of the very best materials that money can buy; all parts are interchangeable and all extras fit to perfection; and all repairs even to the bearings can be made in practically half the time of any other machine known on the market today. Now, this is not idle talk. This machine should be recognized by everyone in need of a crusher and who is ready and willing to investigate the practical features as mentioned above.

The Universal Crusher Co., 304 N. Third street, Cedar Rapids, Iowa, is well known for its strict guarantee and for its many satisfied customers throughout the United States and Canada. If you take into consideration all these vital points, the prices under which these crushers are sold, you will find you can buy the Universal crusher at an extremely low price. The Universal crusher is counted in the line of the most reliable machines today on the market. You can depend on the price, as the policy of the manufacturer is strict, not allowing any "juggling" of prices whatever, or any cutting just for the sake of deceiving customers.

Every crusher is tested and is constructed throughout with the very best materials, and the buyer runs no risk as every part of the machine which proves defective will be replaced free of charge, f. o. b. Cedar Rapids, Iowa. Another point of great importance is —a Universal crusher after a year's use has the greatest cash value, as in many cases the Universal Crusher Company has agreed to exchange small machines for larger ones on a basis of allowing the full price less 12½ per cent should the machine prove too small after one year's installation.

COATING PILES WITH THE CEMENT GUN.

A new use which shows some interesting possibilities for the cement gun process has been found in Seattle. The piles in the city's harbor have been subject to the attacks of what is locally termed the sand-flea. To protect the pile against this insidious pest has been a troublesome problem.

Recently the cement gun has been employed in coating some 500 piles for the Seattle Electric Company. Ordinary poultry mesh was stretched around the piles and a coating of "gunite" from 1½ to 2 inches thick shot on. The gun was operated between tides and the "gunite" set up so quickly that no trouble was experienced from the rising tide.

The results are described as satisfactory. The contract price for doing the work was $4 per pile.

W. Z. WINTER.

W. Z. Winter, who for several years has been representing the Acme Plaster Co. in Iowa and Minnesota, has joined the Northwestern States Portland Cement Co. force of traveling salesmen and will cover Iowa territory. Mr. Winter will still make Ackley his headquarters while in the new work.

CEMENT TILE ON THE FARM.

In regard to the inquiry from Wells County, Indiana, about cement tile, I have had some experience with home made cement tile and find them far ahead of any clay tile. They are fully equal to the best of glazed sewer tile. In the summer of 1904, I made one hundred feet of 24-inch concrete tile using one part Portland cement and six parts gravel and in 1907 made 100 feet additional of same size. Then again in 1909, I made two culverts 26 inches, inside measure. Any of these tile can be examined and will be found to be entirely satisfactory, writes E. H. Upson in the Farmers' Voice.

The one good thing about cement tile is that a farmer can do all his work himself, the only cash outlay being for cement and gravel. Forms for moulding the tile can be made cheaply from plastering lath and ordinary lumber and will last indefinitely if sheltered when not in use. Of course, everybody knows that freshly moulded concrete is very fragile for a few days and should not be taken from the forms until thoroughly set. If the Wells County subscriber ever uses concrete tile, I hardly think he will want to go back to clay tile, especially for outlets to drains.

BRIDGE TRAMWAY.

The illustrations herewith show the new electrically operated bridge tramway designed by the Dodge Department of the Link-Belt Company of Philadelphia and Chicago for the Vigo Washed Sand & Gravel Company. Terre Haute, Indiana, for unloading sand and gravel from barges and delivering to storage bin. The following will give some idea as to the size and capacity of this equipment:

Length of bridge.....365 feet
Capacity of grab bucket.....1½ yards
Hoisting speed of bucket....125 feet per minute
Trolley speed of bucket.....1000 feet per minute

This is one of the most efficient machines ever devised for this work.

The Sand and Gravel Plant of the Ohio Co.

Bitter experience has proved conclusively to all concerned that it is no easy matter to screen properly the materials brought from the bed of the Scioto River, at Columbus, O., by the centrifugal pump on the dredge of the Ohio Gravel & Sand Co. Two different ways were tried, and found ineffective. The present plant is perfectly successful and correspondingly satisfactory. The new plant was installed by The Webster Co.

The Ohio Gravel & Sand Co. owns the land between the junction of the Scioto and Olintangy rivers, and as this is practically solid sand and gravel, the company has a large "bank" to draw from, besides the beds of the rivers themselves.

To get the material a large barge is used, equipped with a 12-in. centrifugal dredging outfit, the screening plant, a settling tank for the sand, and the necessary steam boiler and engine. The dredge barge is moored with long cables which afford ample freedom for moving about as the dredging proceeds.

The delivery from the centrifugal pump is largely water—about 80 per cent water and 20 per cent solid matter. To handle this large volume of water—about 6,000 gallons per minute—and effectively screen the solid materials, proved impossible of accomplishment except by the new patented screen. The first plan tried was the ordinary series of conical screens so largely used in "standardized" types of sand and gravel washeries. It failed completely and was scrapped. A second installation of elaborate and expensive character was then put in by another manufacturer, who planned it "to meet exactly the conditions of the case." This equipment did better than the first, but failed in its most important function and was discarded. The new Webster plant then was furnished and has now done a season's work in perfectly satisfactory manner.

UNLOADING THE SCOW WITH GRAB BUCKET AT THE SHORE PLANT.

LOWER SIDE OF THE DREDGE—A SCOW BEING LOADED.

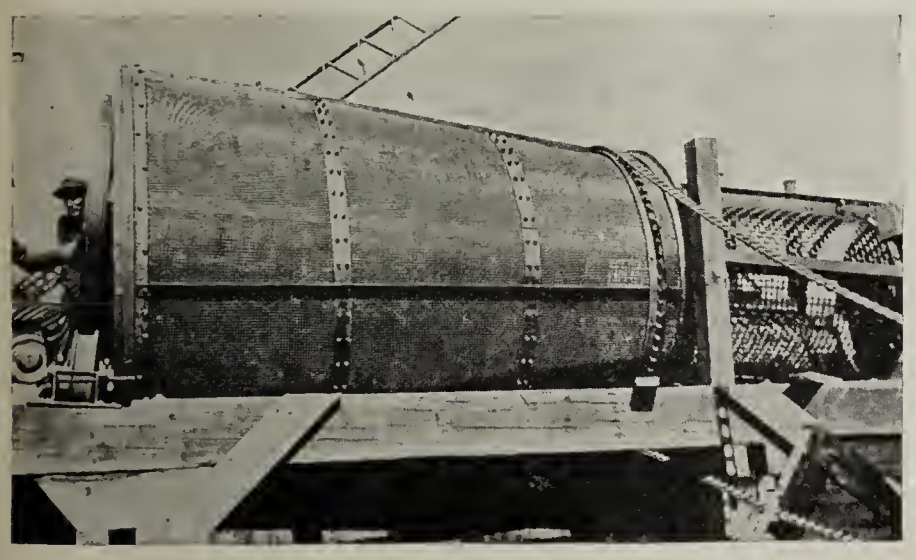
Fig. 2 shows the screen itself during erection. The cylindrical portion within and the conical portion outside are separate in construction, supporting and driving. The cylinder has two woven wire sections of different sizes of mesh and is built up on a stiff frame work of steel. The upper or feed end rolls on trunnion wheels, while the lower is supported by a pillow

block bearing, carrying the shaft on the end of which is fitted the driving gear for the cylinder.

The cone is carried at both ends on trunnion wheels and is rotated by a chain on an annular sprocket around the smaller end of the screen. The cone and cylinder are not concentric and do not rotate together, each being set at its own best inclination and turned at its own best speed.

LOADING THE SCOW WITH 4 SIZES OF MATERIAL.

The force of the stream from the centrifugal pumps is broken by discharging the materials—water, sand, gravel and boulders—into a steel-lined box 6 ft. square, from which they pass into the cylindrical screen. Small gravel and sand passed by the first half of the cylinder fall into the cone and are separated, the small gravel tailing out as rejects and the sand passing through with the water. Large gravel passes through the large meshes at the lower end of the cylinder, the oversize stones tailing out as rejects.



VIEW OF WEBSTER CYL-CONE SCREEN DURING INSTALLATION.

The stones, large gravel and small gravel are passed by wood spouts directly to their respective pockets on a scow moored alongside the dredge barge. The sand, with the dirty water, is sluiced to a settling tank near the boiler house. The water overflows and runs back into the river; the sand is scraped out from the tank by a slow drag conveyor and elevated to spout to a fourth pocket on the barge.

Thus the new cylindrical screen made possible a very compact plant, of large capacity, extending only a few feet above the deck, occupying only a reasonable portion of the available deck space, handling an enormous quantity of water, producing clean and sharply separated materials and delivering them into four piles in pockets on a scow alongside, for transfer to shore.

Two scows are used, one unloading at the shore plant while the other is being loaded at the dredge. A gasoline motor tow boat, readily makes the transfer of scows, with small loss of time. A third scow will avoid practically all this loss of time when the shore plant is ready to handle more than can be unloaded at present. With three barges there will always be an empty at the dredge, ready for quick replacement of the loaded one when its pockets are properly filled.

On shore is a locomotive crane, with clamshell bucket for unloading the scows into a receiving hopper, from which each size as received may be elevated to its proper bin in the storage house above the railroad tracks.

The success of this new installation of Cyclone screens, after the failure of two equipments installed by others, is naturally a matter of justifiable pride to the Webster company and of gratified satisfaction to the Ohio Gravel & Sand Co. Cement & Engineering News, Schiller Bldg., Chicago, will forward to any of its readers catalogues and information on sand and gravel equipment.

APPLICATION OF TILE TO CONCRETE.

By John Wynkoop.

The intensely practical advantages of concrete have so impressed themselves upon the public that there is no longer any question as to its use from that point of view. The beauty and treatment of concrete surfaces, because of this utilitarian development, have not received the important study warranted by the nature of the material. A few authorities advocate leaving concrete surfaces just as they are when the rough forms are removed. However meritorious this may be, the majority of architects look upon concrete as a material which from its very nature gives a most extended opportunity in surface decoration and color. Architecture in stone is essentially dependent upon architectural lines—shade and shadow—whereas architecture in brick or concrete is dependent upon the actual treatment of their surfaces for their character and effect.

From this viewpoint, which is that of the majority of architects, any material enriching the surface of a concrete wall without interfering with its structural strength is possible and worthy of consideration. Of stone, brick pigments and tile, the latter is, undoubtedly, best adaptable because of its beauty and extreme simplicity in application. In France, Italy and America, the application of tile to concrete surfaces has been considerably exploited, so that many actual examples exist upon which to base an opinion as to the effect produced. From these and from the general principles of design involved, it may be seen that extreme accuracy of tile setting as we know the material in general use is harmful to fine effects and not to be desired. Concrete, especially for exterior use should be sufficiently rough and uneven to insure artistic surface modeling when seen from a considerable distance. This necessitates a free and varied treatment of any tile applied to it, both as to setting and as to coloring. The color of the concrete itself, in the main, determines the color scheme of such tiles as are applied to it. Rough and deeply colored tiles are found to blend most easily with the rough surface of the concrete. although it can easily be imagined how certain bands or spots in tile could be both highly colored and finished to bring out accents sought after by the designer.

Especially in country house work the application of tile must be concentrated largely because of the costliness of entirely covering the concrete. As a matter of effect, from an artist's point of view, what a concrete surface needs is contrast with some material which is more refined and decorative than itself. Panels, band courses or scattered designs in tiles, so long as they do not become all-over patterns, seem particularly advisable in this kind of work. As much depends upon concentrating this decoration as does upon an intelligent selection of colors and an artistic placing of the individual tiles. Without doubt there can be no limit to the way in which tile employed in this way may be treated. Practically any size and shape, any color, any surface are being manufactured continually, and along with this molding and special colors and combinations may be obtained, provided the manufacturer considers the amount to be ordered as warranting him to produce special ideas in this way.

In fact, a rather new and certainly delightful avenue of designs has been opened to the architect by the increasing prominence of concrete and its allied arts and materials.—Mantel Monthly.

RIGID LAW NOW SUGGESTED FOR USE OF CEMENT IN LOS ANGELES.

J. J. Backus, chief inspector of buildings, has asked the Board of Public Works to recommend changes in the building ordinance requiring: First, that no concrete for reinforced concrete in buildings be mixed or poured except in the presence of an inspector working under the jurisdiction of the department, the inspector to receive his remuneration from the owner of the building; second, that all test reports be made on blanks furnished by the department and sworn to by the person making the test that it was made conformity with the city ordinances and the provisions adopted by the American Society of Testing Materials. The Board of Public Works, under whose jurisdiction the building department works, adopted Mr. Backus' request and sent it on to the City Council for action.

Mr. Backus explains his position in his communication to the Board of Public Works, which was as follows:

"I respectfully beg to recommend to your honorable board that Ordinance No. 19,900 (New Series), generally known as the 'Building Ordinance,' be immediately amended so that its provisions will make it unlawful for any person, firm or corporation, either as owner, architect, contractor, superintendent, foreman, or in any other capacity, to do any mixing or pouring of concrete in a reinforced concrete building or other reinforced structure or in any reinforced concrete floor or roof slab in any building or structure except in the presence of an inspector under the jurisdiction of the Board of Public Works.

"Further, that this same ordinance provide that the inspector be paid by the owner, or other person or persons erecting or constructing any of the above mentioned work.

"Also that the ordinance be amended so that all cement test reports required to be filed with the board of public works be made out on blanks furnished by the building department, such reports to have thereto attached an affidavit setting forth that the person making the affidavit, personally made for the test or caused the same to be done under his direct supervision, and that it was made in conformity with the provisions of the ordinances of the city of Los Angeles, and in accordance with the provisions adopted by the American Society for Testing Materials. Or, in lieu of this latter provision, I would suggest that the ordinance make it mandatory that all cement used on reinforced concrete buildings and structures or other reinforced concrete work be made by the city cement tester, and that such charges be fixed for the making of these tests as will be necessary to recompense the city for the extra help that will be required.

"My reasons for these changes are that with the number of reinforced concrete jobs now going on in the city, and the number of inspectors that this departments has for this kind of work, it is impossible to have an inspector on the job at all times when mixing and pouring is being done, and I am firmly of the opinion that it is very essential that no mixing or pouring should be done only when an inspector under the jurisdiction of the board of public works is there to see that the proper proportions of cement, rock and gravel be in the mix, and record the date of pouring, as well as to ascertain if the proper amount of steel has first been put in for reinforcement.

"In reference to the second recommendation: As the ordinance is at the present time almost any one can do cement testing, and in some instances young men who are acting as night watchmen on jobs do the testing and they neither have the knowledge nor proper equipment for doing same, and the ordinance does not require that they make affidavit, so, therefore, no one assumes the responsibility for the correctness of the cement test report, and we in a measure have to accept the report of any one who will sign his name as a recognized cement tester, the ordinance not defining what a recognized cement tester is; and I believe that requiring oath to these reports or having the city do its own cement testing, will eliminate a great element of danger."

NEW CATALOG.

Biehl Iron Works, 146 Spruce street, Reading, Pa., have just issued a new catalog giving illustrations, sizes and prices of their buckets for handling concrete. Any of our subscribers desiring information concerning buckets for concrete work should write this company. The Biehl Company is the oldest manufacturer of buckets in the United States.

A GOOD QUARRY SHOT.

Quarrymen have for a long time recognized the fact that Gelatin dynamite is nearly an ideal explosive for all-around work, on account of its water-proof qualities, density and plasticity. Nearly all quarries are liable to be wet at some season of the year, and many have to contend with water all the time. It takes anywhere from an hour to a day to load a good sized shot, and practically no explosives except the

BEFORE THE BLAST.

Gelatins will withstand the action of water in the wet holes for more than a few hours. The density of the Gelatin is that property by virtue of which a vast amount of energy may be stored in very small bulk. The Gelatins are the heaviest and densest explosives in commercial use. The use of Gelatin enables a blaster to concentrate the greater part of the charges in the bottom of the drill holes, which is advantageous in that it increases the amount of tamping possible, and in block hole work, it enables one to fire a small charge in the bottom of a hole which will break a spall with a minimum amount of waste from small pieces and chips. For lime manufacturers this is an especially valuable feature, as the small fragments of rock are usually of no value. The third property of this "ideal" explosive is its plasticity. Gelatins are physically similar somewhat to well-worked putty, and can be molded, sliced and worked into seams and fissures in the rock and expanded by means of a suitable tamping stick to fill all the cracks and crevices, excluding air spaces and increasing the effective force of the explosive accordingly. "It stays where it is put."

A new Gelatin has lately appeared upon the market having all the desirable features of its well-known predecessors, but having the additional virtue of a very low freezing point. It is just as plastic, dense, water-proof and reliable as former Gelatin explosives. It is no more difficult to explode and is just as agreeable to handle. The freezing point of all nitroglycerine explosives is never exactly fixed, but varies somewhat with physical conditions. The new Gelatin which is known as Du Pont Gelatin, will not freeze above 32 F., while it has been known to withstand temperatures below zero for several weeks without freezing, although such extreme resistance to cold is not expected of it. In ordinary quarry work, a Gelatin which will withstand ice-cold water without freezing is about all the most exacting quarryman can ask.

At the quarry of the Lee Lime Company, Lee, Mass., a blast was made recently using this Du Pont Gelatin in a ledge of dolomite. This rock is used for making a high-grade chemical lime, and is all hand picked for the kilns. There were 21 holes in the ledge, 16 feet deep, about six feet apart, having an average burdn of 11 feet. Everyone of these holes contained water. From 23 to 27 cartridges of 1⅛x8-inch Du Pont Gelatin were used for each hole. It took about two hours to load and fire this blast. The ledge lay in a horseshoe curve, so that the shot had to break down an arch. The photographs shown give a good idea of the conditions before and after the blast. In this dolomite rock no attempt is made to break the rock to the required size in the first place, as to do this results in too much waste. A good shot would have about 60 per cent of the rock in such shape that it could be handled immediately, the rest would have to be broken again by block hole shots. Block holing is done by means of an air plug-drill which drives a hole eight inches deep in about two minutes. Only one-third of a cartridge of 1⅛x8-inch of Du Pont Gelatin was used for breaking up each of the blocks shown in the "after" photograph, except the large one near the center of the picture, which required one whole cartridge. This method of secondary firing makes for great economy in the amount of explosives used, and with the Du Pont Gelatin a few cartridges may be kept on hand in the quarry throughout the winter, eliminating the necessity of going to the thawing house every time a round of block hole shot is fired.

SAND-LIME BRICK

There has recently been completed at Scarboro, Ontario, a modern, up-to-date sand-lime brick factory by the Toronto Brick Company, Toronto, Ontario. This factory is the latest in design in sand-lime brick manufacture and was installed by the American Clay Machinery Company of Willoughby, Ohio. The brick turned out of this factory is the hardest and best of any sand-lime brick factory in Canada.

AFTER THE BLAST.

DULUTH SALES OFFICE.

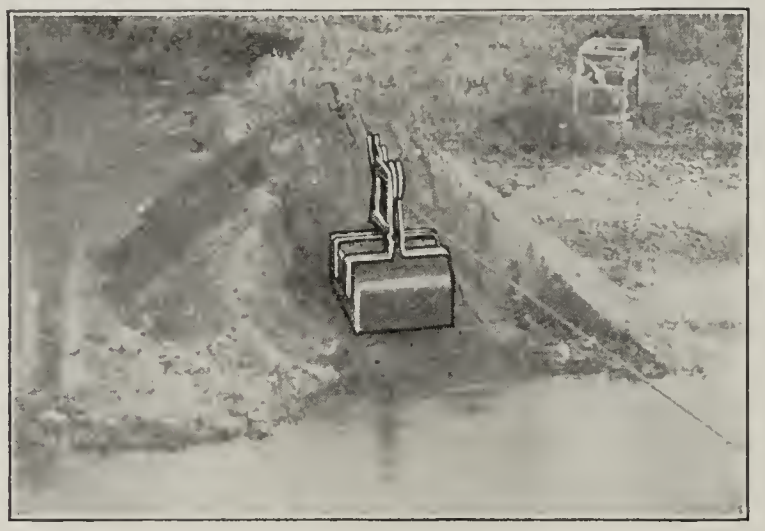
"Mr. J. W. White, engineering salesman for The Jeffrey Manufacturing Company, located until recently at their Athens, Ohio, offices has been transferred to Duluth, Minn.

"Mr. White will look after the sales work of the above company in the following territory: The eastern part of Minnesota, Northern Wisconsin, and the entire Upper Peninsula of Michigan, with headquarters at 1905 East Superior street, Duluth, Minn."

THE NEGLEY PATENTED EXCAVATOR.

The Negley Patented Excavator, illustrated herewith is a revelation in the excavating machinery world. It was invented and patented by Mr. Claude E. Negley, of Indianapolis, Indiana, and is manufactured by the Indianapolis Cable Excavator Company, Indianapolis, Ind.

Mr. Negley was for years in the sand and gravel business, and came in personal contact with the troubles which are experienced often in that business, necessity being the mother of invention, it only required a study of the causes, of the effects that were realized from day to day, to bring an excavator upon the market which was second to none, for efficiency, economy and durability.



LOADING.

This excavator is operated on a slack cable, with a two drum friction hoisting engine, the front drum operating the load line, which controls the loading, transmission and dumping, either a fast, or a slow, dump is obtainable at will of the operator, the rear drum operates the tension line, which by means of fall blocks, connected to the main cable, controls the raising and lowering of the excavator.

DUMPING.

The latch, or locking device, is so constructed, that it will maintain the engaged position, until it is released by contact with a stop on the main cable, and it never fails to engage.

The excavator is built compact and strong, with very few wearing parts, all of which are reinforced, it is a durable and rapid working machine, and is adaptable to all uses for a slack cableway excavator.

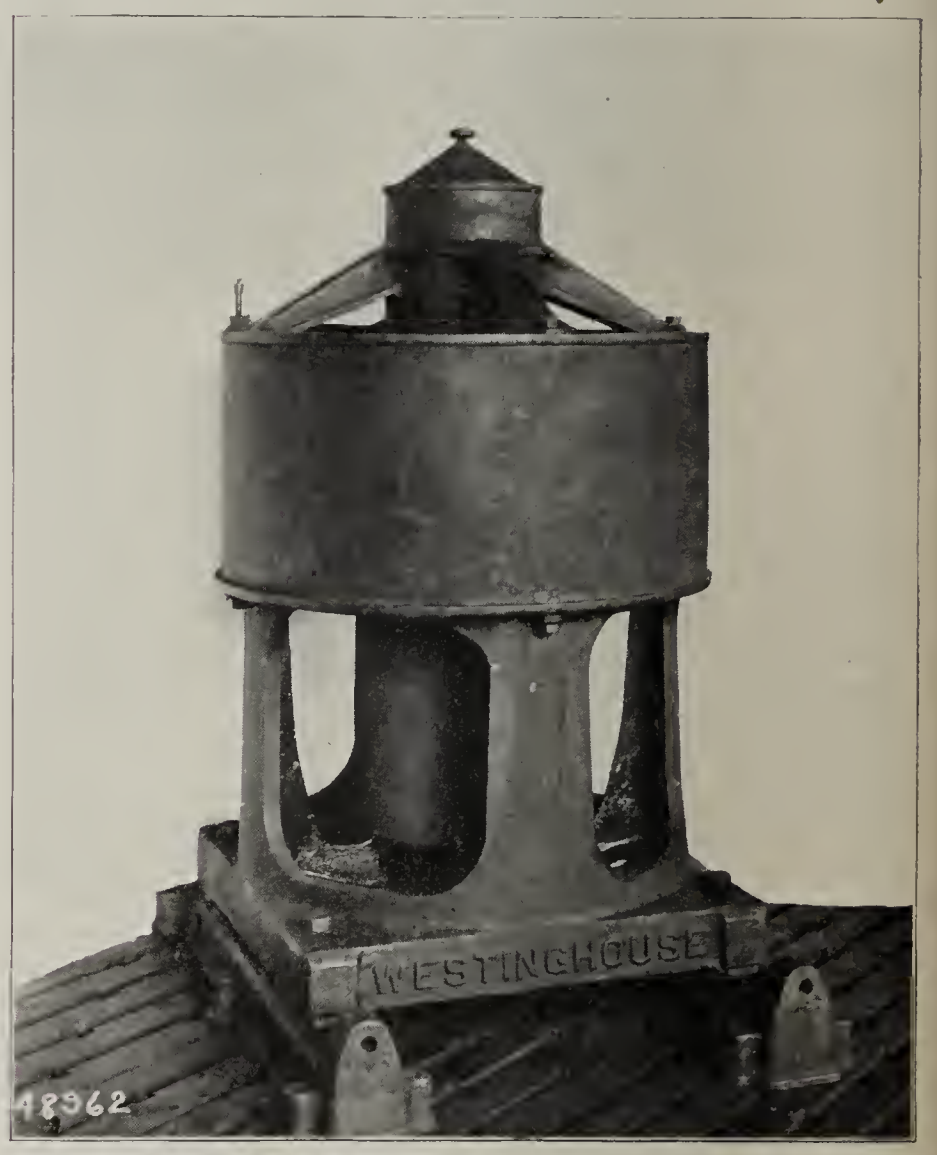
We encourage investigation by all interested persons.

A NEW VERTICAL MOTOR FOR CEMENT MILLS.

In order to provide a thoroughly satisfactory drive for vertical machinery (such as grinders and pulverizers) in cement mills and other places where the service is very severe, the Westinghouse Electric and Manufacturing Company has built a line of specially designed vertical motors in sizes varying from seventy-five to two hundred horse power, for both direct and alternating current circuits.

The special feature of this motor is its strong, rugged construction. The motor frame is supported by a massive cast iron base, which rests on slide rails with belt-adjusting screws.

The shaft is of very large proportions and the bearings are designed to withstand the severest stresses. The weight of the motor and the major part of the horizontal thrust due to belt tension are carried by a ball bearing mounted within the motor base. This



bearing is housed in an iron case and can be easily removed if the necessity arises.

The bearings are automatically oiled, the oil being forced betwen the bearing surfaces whenever the motor is in motion. The ball thrust bearing runs immersed in oil.

The pulley is mounted inside the thrust bearing, which together with the strength of the shaft and the rigid support afforded by the motor base, insures the elimination of distortion due to the belt tension so that the proper clearance is always maintained between the stationary and rotating parts.

The commutation of direct current motor is practically sparkless, so that brush renewals are rarely required and commutators are long lived.

The principal features of construction are shown in the accompanying illustrations.

AN IMPROVED GATE VALVE.

The extensive use of the valve herewith illustrated, has demonstrated that its durability and efficiency are fully appreciated by steam users all over the world. They are specified by the leading engineers for use in high pressure power plants.

This valve can be had made entirely of Brass or Iron Body Brass Mounted, in "Puddled" Semi-steel and also Cast Steel.

Medium Pattern Brass Valves, sizes 2 to 8 inches inclusive, are guaranteed for working pressures up to 125 pounds, and from 9 to 12 inches for pressures up to 100 pounds. Extra Heavy Brass Valves will safely stand 250 pounds pressure. The Iron Body Brass Mounted Valves are made in Standard, Medium, Heavy and Extra Heavy Patterns, the Standard Pattern, sizes 2 to 8 inches inclusive, for pressures below 125 pounds, and sizes 10 to 24 inches, for pressures up to 100 pounds. Medium Pattern has been designed for 125 pounds; the Heavy for 175 pounds and the Extra Heavy for 250 pounds. For high pressures and superheated steam these valves are made of "Puddled" Semi-steel, the tensile strength of which is 30,000 pounds, sizes 1½ to 16 inches inclusive, and to meet the specifications of engineers who differ as to the metal used for the trimmings, they are made in two combinations. They are guaranteed for working pressures up to 250 pounds.

For extreme conditions of pressure and superheat, the valves are made of Cast Steel, having a tensile strength of about 80,000 pounds per square inch.

They are also made in sizes ranging from 1½ to 16 inches inclusive, and in two combinations,—one for pressures up to 300 pounds and the other for 350 pounds.

As clearly seen by the illustrations, the valves are made in two forms; one with stationary stem, and the other with outside screw and yoke.

The seat rings, as well as the wedge disc, can be renewed when worn, thus making the valve as good as new.

A very desirable feature in the construction of the valves, is the fact that when finishing the interior of the valve body, that portion which receives the seat rings is threaded to the correct angle of the tapers of the valve disc. The seat rings are threaded and faced off straight, and when screwed in place, they fit accurately to the tapers of the disc. This consequently makes it possible to easily renew the seat rings, should they become worn or broken,—hence, prolonging the life of the valve.

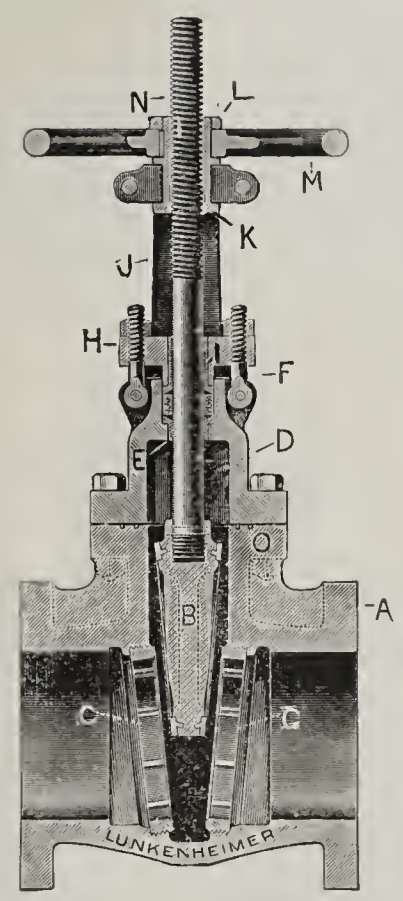
The discs in both forms of valves are made entirely of bronze up to and including the 6-inch size, on the Medium, Heavy and Extra Heavy Patterns, and up to the 3½-inch size on the Standard Pattern, above which they are made of iron with bronze face rings. As the valves are double seated, they will take pressure from either end.

Either pattern of the Gate Valves can be packed under pressure when wide open. The stuffing-box in the valve with stationary stem, is made of bronze, and is tightly screwed into the hub. In the valves with outside screw and yoke, both the gland and stuffing-box are lined with bronze bushings, which forms a perfect bearing surface for the stems.

The discs are accurately guided in the bodies, and by means of the guides, the stems are relieved of all side strains, which have a tendency to wear out the threads on same. The stems in both forms of valves are made of rolled tobin bronze, a material having the tensile strength nearly equal to that of steel.

All parts of the valve are heavy, yet compact, and the strains on the connecting pipes, due to the weight of the valves, are minimized. The valves are not affected to any extent by expansion or contraction.

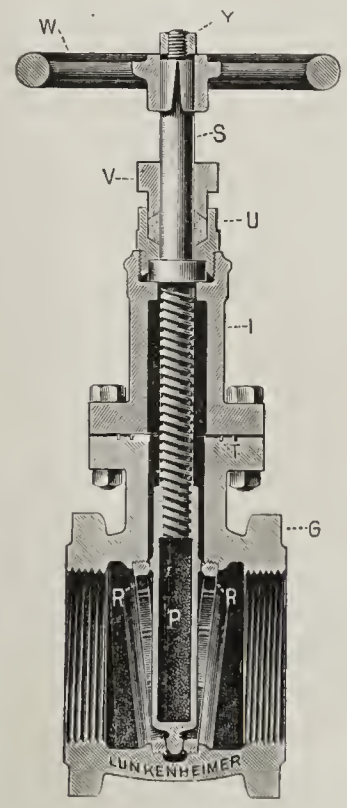
The joint between the body and hub is worthy of attention, for the reason that it is practically indesructible. It consists of grooves cut in the top surface of the valve body, in which are placed seamless copper gaskets. A joint made in this manner will never



leak, and cannot wear out. The yokes and hubs are rigidly held to the body by large steel bolts, both the heads and nuts of which seat on spot-faced surfaces, insuring even and true bearing surfaces.

The valve can also be had with exterior by-pass, a detailed view of which is also herewith shown.

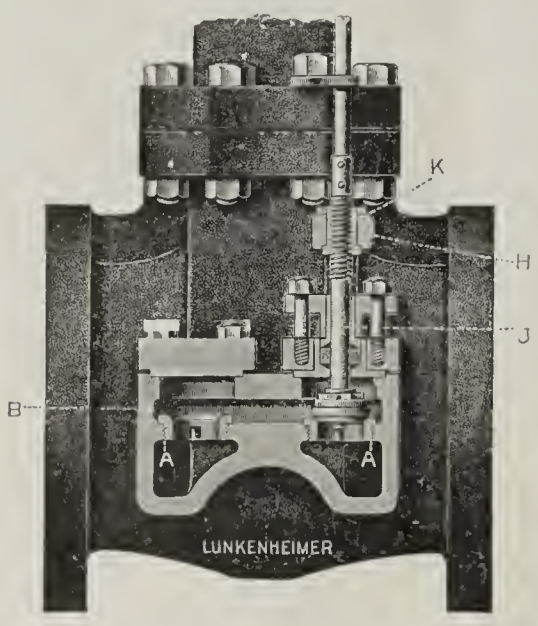
The By-pass used on our "Victor" Valves is not separate from the valve proper, but it is cast integral with



the body, as will be seen by the illustration, and this method has many points of excellence. The additional metal required for the by-pass tends to strengthen the valve body; being self-contained, it is not affected by extremes of expansion and contraction, which tend to

distort the valves used on exterior by-passes. It will be seen that, instead of the by-pass valve trimmings being screwed into the body, they are bolted thereto (as is also the flange above the reserve valve seat) by a number of large steel studs and nuts, the latter seating on the spot-faced surfaces. The stuffing-box is made of bronze and has a flange on the bottom thereof, which prevents the iron flange above it from touching the iron body, and hence, prevents the corrosion between these surfaces.

The outside screw and yoke H increases the durability of the threads on the stem J, owing to the fact that they do not come in contact with the steam. The bushing K, which is threaded to receive the threads on the stem J, not only prevents corrosion, but also makes it possible to renew the same, should the threads become worn.



The discs in both forms of by-pass Valves are constructed on the same principles as those in our Regrinding Globe Valves, and consequently, they can be reground when worn.

The areas of our By-passes are sufficiently large to admit enough steam around the disc to quickly equalize the pressure on both sides. They are accessible at all times, and the use of a by-pass on large valves, or those of any size subjected to high pressures, results not only in making the valves easier to operate, but in largely increasing their durability.

The Lunkenheimer Company, of Cincinnati, Ohio, are the manufacturers of this Valve, and the patentees of the improved form of by-pass used thereon. They have given the valve the trade name of "Victor," and have recently issued an attractive book which thoroughly illustrates and describes the entire line. A copy will be sent to anyone interested.

CONCRETE ROADWAY.

At the close of the recent Springfield Good Roads Convention, Mayor Thos. F. Doyle, of La Salle, headed a delegation from that city in conference with the Illinois State Highway Commissioners on the question of building a permanent roadway from the Rock Island depot at La Salle to a point one mile south.

Plans and estimates for the work were prepared by the state highway engineer, and were laid before the La Salle board of highway commissioners on Monday of last week, meanwhile, interest in the project was aroused, among the producers of roadway material in the state.

F. W. Renwick, president Joliet Sand & Gravel Co., Chicago, considered the enterprise a laudable one, and consented to furnish free the gravel, consisting of approximately 2,800 tons, or 95 carloads, of this material. The Marquette Cement Mfg. Co. and the Chicago Portland Cement Co., Chicago, demonstrated similar interest, and will jointly furnish without cost the cement required, amounting to 26 carloads. The American Sand & Gravel Co., also of Chicago, stands sponsor for 54 carloads of sand, which will be shipped as required, from sand pits at Buda and Lincoln.

At a meeting of the La Salle board of highway commissioners, held at La Salle on Wednesday, February 5th, letters were read from the donors and their respective offers formally accepted, the board appropriating the sum of $5,000 to defray the cost of labor and fuel incidental to the work.

The Illinois Highway Commission at Springfield were then petitioned to supervise the building of the road, and in granting this request the state highway engineer named May 1st as the date on which the work will proceed.

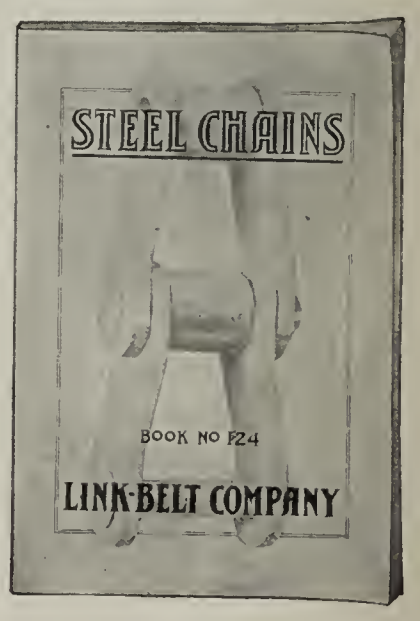
The specifications of the state highway engineer call for a roadway nine-tenths of a mile long, twenty feet wide, with an average thickness of seven inches. It will replace the old road at a point where it is subjected to heavy traffic, La Salle being the most convenient market for the prosperous farming community immediately south of the city, and which must necessarily travel this highway.

The old road is in very bad condition, and has on that account been a source of complaint among farmers, hence the activity of the La Salle board of highway commissioners, who now express keen satisfaction in the rapid culmination of their plans for the replacing of it with a permanent highway of the most approved type.

The generosity of a number of Chicago business men, who in donating the materials, have thereby contributed 60 per cent of the cost of this roadway is also a source of gratification to the citizens of La Salle and vicinity generally.

STEEL CHAINS.

The Link-Belt Company, Philadelphia, and Chicago—manufacturers of the Original Ewart Detachable Link-Belt and the largest manufacturers of elevating, conveying and power transmission chains in the world—have recently issued a new forty-eight



page book illustrating and listing their line of steel chains.

In the manufacture of this particular type of chain, they have taken advantage of every facility their vast experience, modern equipment and skilled workmanship could supply, without wasting expense on use-

less outside finish or appearances, in an endeavor to furnish a product that would have a truer, smoother, harder, and more durable surface.

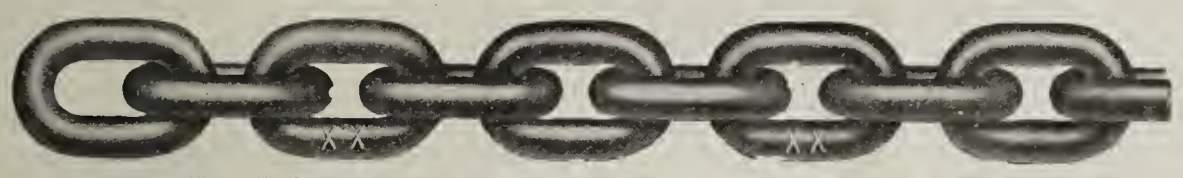
The book should be of interest to the trade and will be mailed free upon request to the Link-Belt Company at Philadelphia or Chicago.

"XX" STEAM SHOVEL CHAIN

The Hayden-Corbett Chain Co. Columbus, Ohio, manufacture a very high grade chain for use on all makes of steam shovels, which they call their "XX" steam shovel and dredge chain.

This chain is made of a triple refined and reworked iron of the highest tensile strength, elasticity and hard-wearing surface, made to their own formulae. Only the most expert chainmakers are employed in making this chain.

They have been making this chain for about ten years, always aiming and striving to improve the quality, wherever it was possible to do so, both as regards the iron and workmanship. They now claim their "XX" steam shovel and dredge chain will more nearly meet the very exacting and strenuous requirements of the steam shovel user than any other chain made, will give less trouble and much longer service. They have unsolicited letters from contractors and cement, gravel, sand and crushed rock producers, claiming their chain lasts on an average fully 50 per cent longer than any other chain they have ever used.



"XX" STEAM SHOVEL AND DREDGE CHAIN.

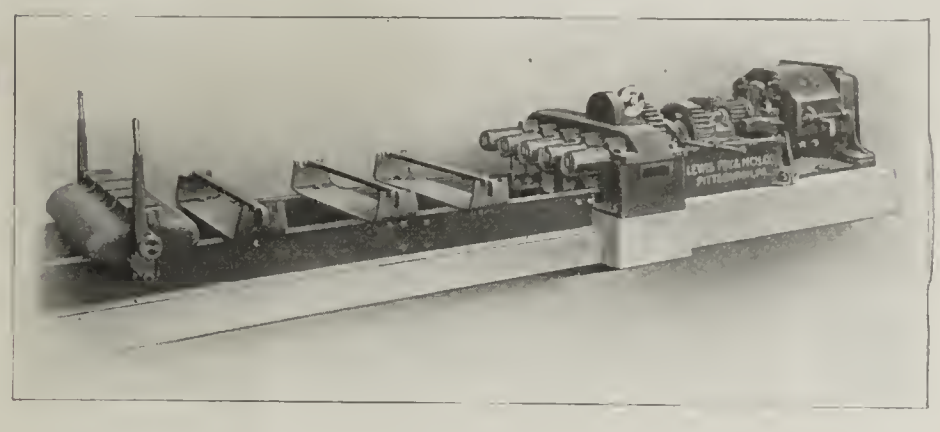
We are also informed by them that the "XX" hoisting chains are to be found on the shovels on most of the big projects today, working day after day, and are giving the very best of service in every instance.

The best testimonial of the superior value of their hoisting chains is the fact that they sold more hoisting chains the past year than ever before. This would indicate that the steam shovel crews are fast learning that the "XX" steam shovel chain gives them less trouble, have fewer breakdowns, less loss of time, etc., than with other chains and insist on having this particular make of chain. Their chains are made in all sizes and they are fully guaranteed. Write them for their new catalog.

MOTOR OPERATED BAR TWISTER.

In concrete work the steel bar gives the tensile and the concrete the compression strength. In order to produce a bar having a high elastic limit and homogeneous texture, it is essential that continuous and uniform running be attained on the machine used in twisting these steel sections. A great deal of trouble is experienced with belt driven machines on account of belt slippage causing unnecessary strain during the twisting process, which usually results in an inferior product due to the elastic limit of the bar being exceeded. With a motor gear-connected to the machine, as shown in the accompanying illustration, an occurrence of this kind is practically impossible, since this method of motor connection insures constant torque being applied during the time the bars are being twisted.

The type of machine here shown, manufactured by Lewis Foundry and Machine Company which is used for twisting Ransom bars, is arranged for two speeds. A seventy-five horsepower Westinghouse mill motor is used on five one and one-quarter-inch bars, and a sixty horse power motor on five one-eighth-inch bars.



The twisting heads are steel castings arranged to receive tool steel dies for bars three-eighths inches to one and one-quarter inch advancing by eighths of an inch. Bearings are brass brushed, and the shafts turned and hammered openhearth steel. The bed is made of ten inch channels of sufficient length to accomodate sixty foot bars. The tail stock is so arranged that it may be locked on bed at any distance from head stock. An index is provided to register the number of turns made by the bar twisting head. The dial is reset by hand, and can be moved back to zero when the load is released. The twisting speed of the head is about sixty r. p. m. for one and one-quarter inch bars; taking about one minute. The time consumed in loading and unloading is about two minutes; consequently, a complete cycle occurs every three minutes. One complete standard twist will occur on one and one-quarter inch bars in twelve and one-half inch, and on one inch bars in ten inches.

A NEW KEROSENE ENGINE

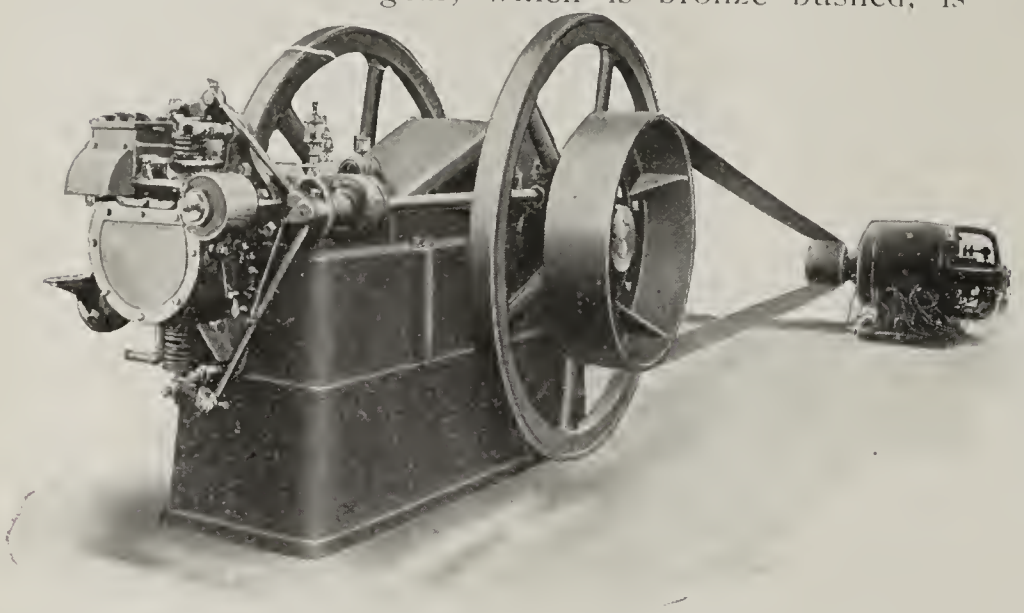
The M. Rumely Company has recently placed on the market a kerosene engine built in sizes ranging from 50 to 200 brake horsepower and designed for general power purposes. It is known as the Rumely-Adams gas engine and its design and construction are shown in the accompanying illustration.

The principal feature of this engine is the carburetor, by means of which the kerosene is used direct without preheating, exactly as gasoline is used in a gasoline engine. This improvement has simplified the kerosene engine so that it is no more complicated than any other internal combustion motor and has increased its economy and reliability. A side view of the engine is shown herewith. The patented carburetor is known as the Secor-Higgins carburetor and the patents covering it are owned by the M. Rumely Company.

The original invention on which the carburetor is based was made by John Secor, one of the pioneer oil engine builders of the United States. Following Mr. Secor's primary invention, his services were secured by the M. Rumely Company, which went exhaustively into the design of a carburetor to handle kerosene without preheating, exactly as gasoline is used.

The carburetor consists of three chambers containing gasoline, kerosene and water, respectively. The gasoline is simply used to start the engine and is turned off after the machine is in motion. The water is injected with kerosene to keep down the excessive heat. The large port A, connects the carburetor chamber B, with the engine cylinder. Air is drawn through the chamber B, and the kerosene drips through a series of openings in the tube T. The kerosene is so finely divided in entering the air chamber that it vaporizes readily and mixes with the current of air moving toward the engine. The water is added to the mixture in the same manner. The entire carburetor mechanism is contained in a rigid cast iron box and is fitted with an aluminum valve operated by the governor.

The engine embodies the latest features in the design of large internal combustion motors. The lay shaft is operated by a set of spiral gears. The inlet and exhaust valves are of the poppet type and are fitted to the top and bottom of the cylinder head. They may be removed readily for cleaning or inspection. The valve gear, which is bronze bushed, is



VIEW OF THE RUMELY-ADAMS KEROSENE ENGINE.

equipped with rolling and multiplying levers of the silent operating type.

The frame of the engine is cast in one piece. A hard, close-grained, semi-steel liner is forced into the cylinder, the space between the liner and the external wall forming the water jacket. The piston is made of the same hard material as the liner. The bearings and pins are made of the same hard material as the liner. The bearings and pins are of unusual size.

The combustion chamber is nearly spherical in form and is free from small pockets. It is cooled by the deep water spaces which surround it. The cranks are counterbalanced to insure smooth running and the crank case is completely enclosed. A multiple oiling system is used, every part being provided with a direct oil feed which drains to a common tank from which the oil may be drawn out or filtered. The ignition is of the make-and-break type, the current being supplied by a high-tension magneto of the rotary type, geared to the lay shaft. The engine is provided with a governor designed to regulate the speed within 3 per cent, or for special service may be equipped so that the speed will not vary over 2 per cent on sudden changes of load.

The engine is especially designed for manufacturers and to operate on either kerosene, power distillate, or gas oil. It will also operate on gasoline or any of the oils of the naphtha group. At any load from one-third to full load, using kerosene or other oils for which the engine is designed, it will develop more than ten brake horsepower to the gallon.

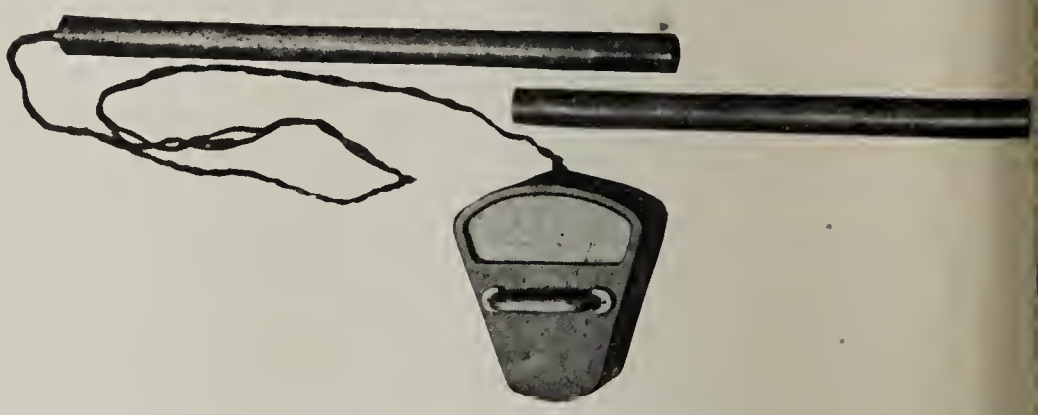
RADIATION PYROMETERS.

Radiation pyrometers are well adapted for use in cement plants, for determining the interior and exterior temperatures of the kilns, while thermo-electric pyrometers should be used to determine the temperatures in the stacks, thus enabling the burner to gauge

RADIATION PYROMETER AT KILN HEAD.

his drafts correctly and economize fuel, as well as improve his product. The Thwing radiation pyrometer manufactured by the Thwing Instrument Co., Philadelphia, Pa., has been tried out in a majority of the cement plants in Pennsylvania, and the chemists have as a rule admitted that the apparatus would be of great value to determine kiln and stack temperature. The Universal Portland Cement Co., Chicago, Ill., have used a radiation pyrometer for nearly a year, measuring the interior temperatures of their kilns, and the loss by radiation due to the kiln wall; while the Dexter Portland Cement Co., has used a radiation pyrometer for six months, and have equipped their stacks with a thermo-electric outfit. With the joint outfit, they were able, it is stated, to improve their production, at the same time increasing the production of one kiln which was not being fired to the best advantage, as was determined by the pyrometer reading.

In a radiation pyrometer, the total energy of radiation is measured by the current generated in the sensitive thermo-couple by the radiations concentrated upon it. This is based on the Stefan-Boltzmann law. The accompanying illustration shows the operation of the pyrometer.

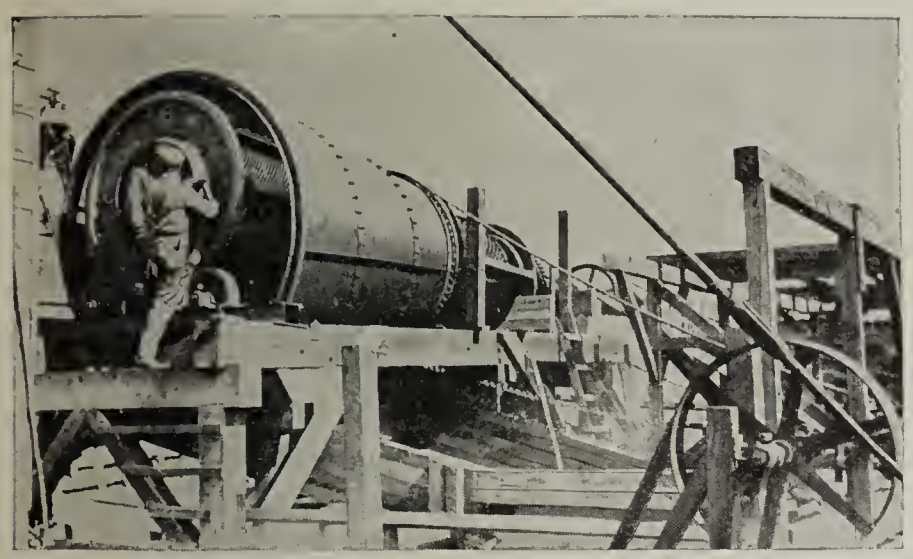


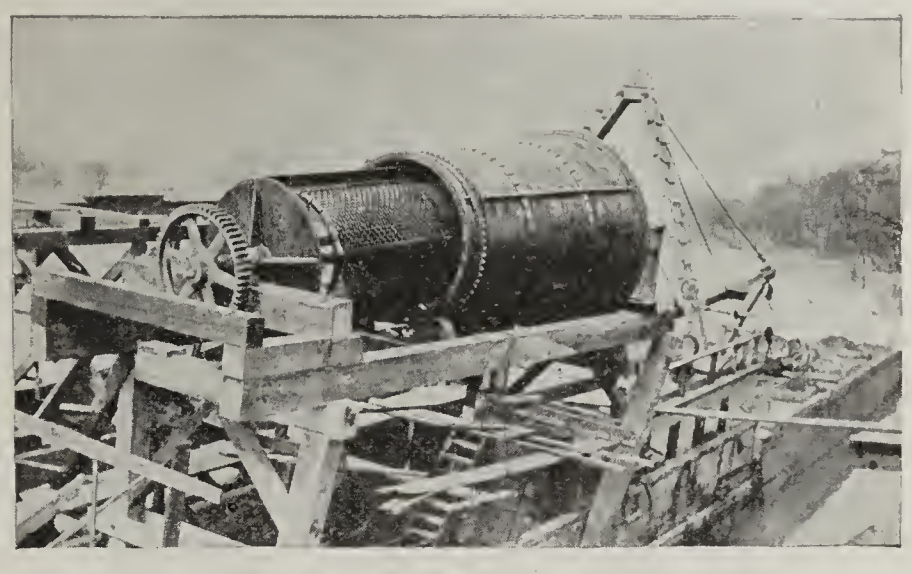
NEW SCREEN FOR WASHING SAND AND GRAVEL.

A new method of washing sand and gravel has been developed in the "Cylcone" screen recently placed on the market by the Webster Manufacturing Co. The design of the new screen, for which patents are pending, is a combination of the cylindrical and conical revolving screens in common use.

The main body of the screen is a straight cylinder with different sized perforations extending its entire length. The conical section is in the nature of a jacket surrounding the first section of the perforations in the cylindrical screen.

The screen is designed to separate and wash several grades of material, and distribute each grade to a separate bin without the aid of auxiliary conveyors. The





screen distributes the four coarsest grades of material into adjacent bins, while the sand, after passing through two screening surfaces, is sluiced with its washing water to the settling tank over the end bin.

A modification of the design is introduced by lengthening the dead plate section and equipping it with baffle plates. This is done where the material contains an excessive amount of dirt and loam, and requires considerable agitation to remove these impurities. By means of slight variations in the design a classification of materials ranging from three to seven different grades can be obtained.

The arrangement is such that the tops of the material bins can be at the same elevation, and if desired, of equal capacities. One of the chief advantages of this lay-out, according to the manufacturers, lies in the reduced height required for elevating the raw material. This amounts to from 40 to 50 feet above the ground level, which is considerably less than is generally found in the ordinary type of plant. The cost of machinery is also said to be materially less where these screens are employed and this is accompanied by a reduction of operating and maintenance costs.

Making Wonderful Endurance Records in the Cement Mills

The success of Longlife Conveyor Belts is a plain case of "survival of the fittest." When mills similar to yours come back repeatedly with orders covering their conveyor belt requirements—what stronger evidence of merit can you ask? Over 14,000 feet of

Longlife
CONVEYOR BELT

have been shipped this year, to date, to the Universal Portland Cement Company. This belt is handling hot stuff, too.

This concern finds the use of "Longlife" is insurance against interruptions and shut-downs.

Next Time You Need a Conveyor Belt Specify "Longlife" in Your Requisition

B. F. GOODRICH CO.

Makers of Goodrich Tires and Everything That's Best in Rubber

Factories, Akron, Ohio **Branches in All Leading Cities**

STEEL SIDEWALK FORMS.

Plank for sidewalk forms is getting to be a thing of the past. And it certainly should be relegated to the junk pile, when there can be found on the market such a convenient, time-saving device as the Heltzel

all-steel sidewalk forms, made by W. B. Jones Boiler Company, Streator, Ill. These forms have rigid side pieces of No. 10 Bessemer steel, with cross pieces of No. 8 Bessemer. These latter are made adjustable to any of the standard widths of walk. Flexible side pieces for curves are also provided, these being made of No. 12 spring steel. These forms guarantee a correct expansion joint, that requires no parting sand, and it is impossible for them to get out of square. They furnish a perfectly straight edge to draw on. Groover needs only to follow line made by removal of dividing plate, which is removed first, leaving side rail in long as possible to protect edge. They are easily kept clean and can be used at least two or three times a day—on a dry day four times. They are light to handle. The W. B. Jones Company makes an offer of ten days' free trial.

NEW CEMENT BRICK MACHINE.

The Besser Manufacturing Company who have recently placed a very successful brick machine on the market for making cement brick have the following to say concerning this machine which is illustrated herewith: "The cement brick business hasn't prospered like the block business. That's because the cost of cement brick at the factory has been too high. The hand brick machines and some of the power brick machines have made a good product, but it couldn't compete with common clay brick.

The Besser Power Brick Machine has a capacity of from 50,000 to 60,000 brick per day. These brick are being made on this machine for from $3.50 to $4.50 per thousand. They compete in price and excel in quality the clay brick made by the old-fashioned, expensive kiln-burning methods.

This machine tamps the cement mixture into brick molds. The mixed material is elevated into a hopper, which feeds into sets of molds revolving on a cylinder. These molds pass under automatic power tampers which tamp the molds full. The surplus mixture is scraped off automatically, the face of the brick is troweled and two mechanical arms pick up the pallet-full and deposit it on the kiln car.

No human hand touches the material from the mixer to the curing rooms—the machinery does it all.

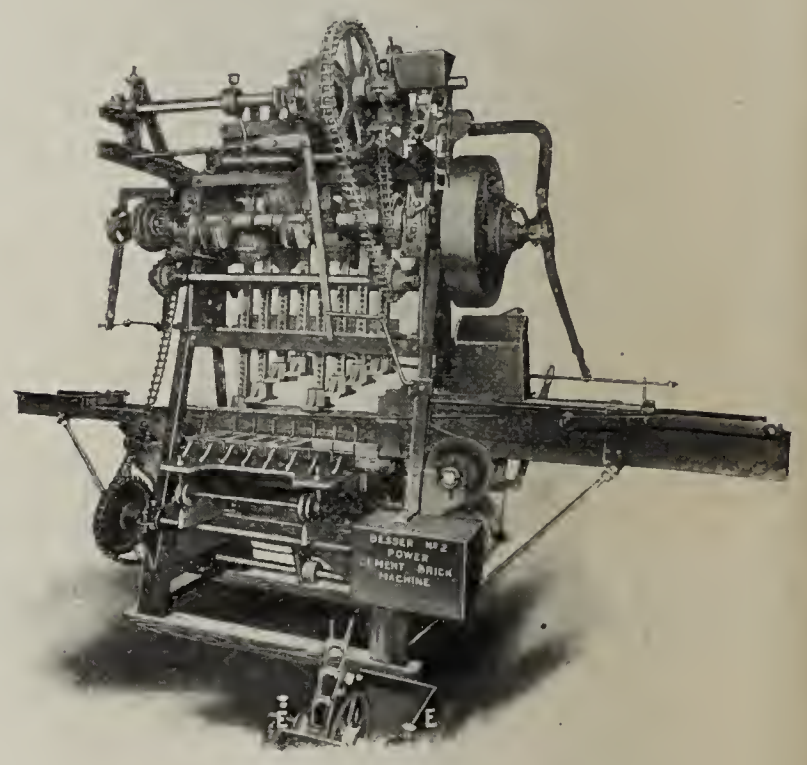
The result is a dense cement brick, hard as flint. It is stronger, more water-proof than a clay brick and can sell for the same, or a lower price.

We make a machine of smaller size with a capacity of 25,000 brick per day. Ask for our Power Brick Machine Catalog. Besser Manufacturing Company, care of Cement & Engineering News, 1117 Schiller Building, Chicago."

Herman Besser, president of the Besser Manufacturing Company states further regarding this brick machine: "I'm proud that I build a machine that will make good, honest, strong, waterproof cement brick that can meet clay brick prices right next to the clay brick yard.

"But I'm prouder of the fact that I have lighted on the only correct principle of molding concrete. That's a feature of this brick machine.

"The hopper feeds into the mold more concrete than is needed. Each brick is tamped by a separate, independent tamper. This tamper tamps the concrete until the mold—every corner of it—is full. Then the surplus is scraped off. You can't measure concrete into a mold and then apply pressure enough to make the concrete just fill the mold—mixed concrete can't be measured that accurately. You can't push it into the mold—one brick would be too large and the next one would be porous. You've got to feed more concrete than you need—let the variation of amounts be in the surplus, not in the product."



SOUTHWESTERN STATES PORTLAND CEMENT CO.

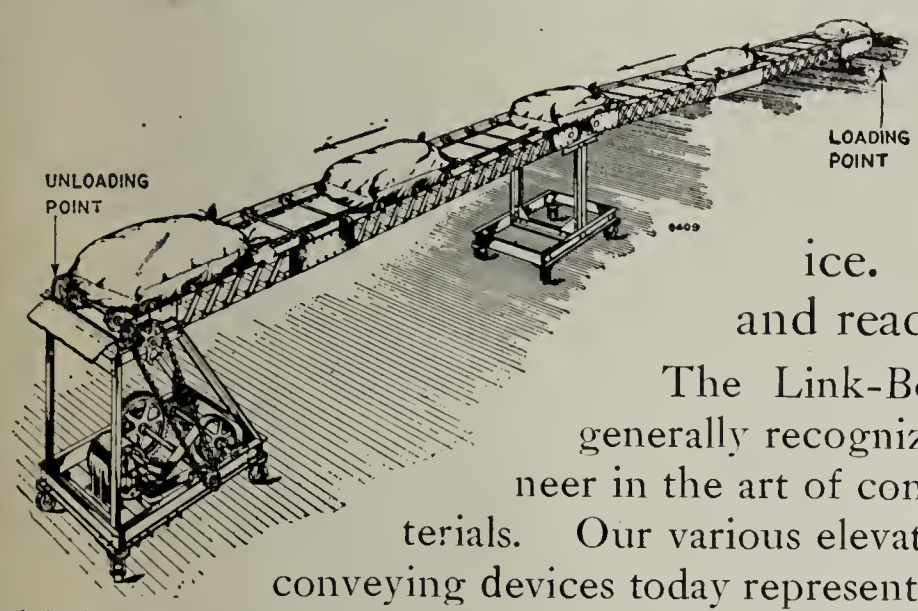
At a recent meeting of the stockholders of the Southwestern States Portland Cement Company, Dallas, Texas, the following officers were elected: C. H. McNider, president, Mason City, Iowa; T. H. Dinsmore, vice-president, New York City; C. H. Wagner, vice-president, Minneapolis, Minn.; C. I. Jones, treasurer, Lincoln, Neb., and H. R. Breck, secretary and general manager, Dallas.

LINK-BELT

Portable Bag Pilers and Sectional Conveyors

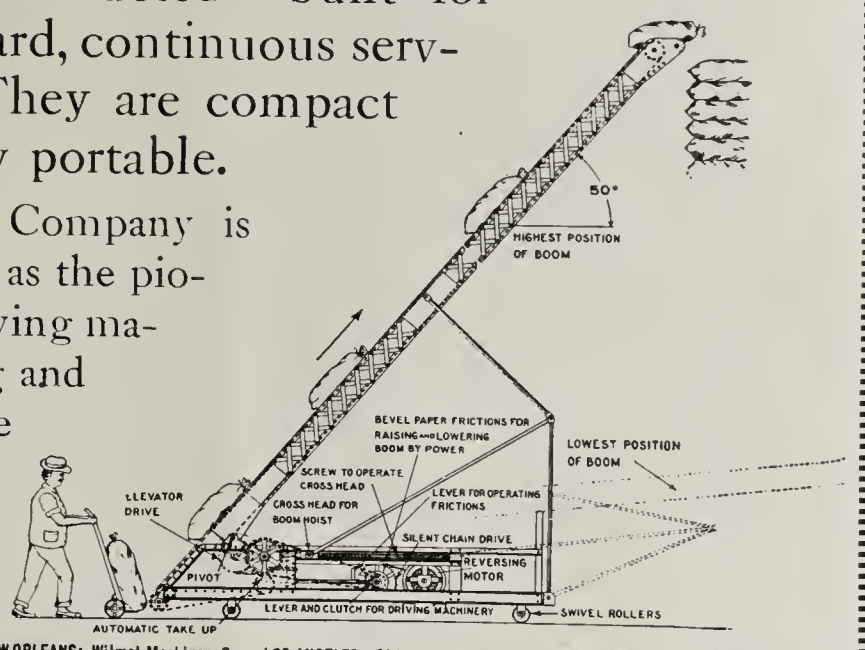
Cutdown handlingcosts and materially increase the efficiency of your entire force
Low in first cost and operating expense.

Full particulars on request



Like all Link-belt Machinery, our Portable Bag Pilers are substantially constructed—built for hard, continuous service. They are compact and readily portable.

The Link-Belt Company is generally recognized as the pioneer in the art of conveying materials. Our various elevating and conveying devices today represent the highest development of their respective types.



LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

NEW YORK: 299 Broadway
BOSTON: 131 State Street
PITTSBURGH: 1501-3 Park Building
ST. LOUIS: Central Nat'l. Bank Bldg.
BUFFALO: 596 Ellicott Square
BIRMINGHAM: General Machinery Co.
SEATTLE: 512 1-2 First Avenue S.
DENVER: Lindrooth, Shubart & Co.
SAN FRANCISCO: N. O. Phelps, Sheldon Bldg.
NEW ORLEANS: Wilmot Machinery Co.
LOS ANGELES: 204 N. Los Angeles St.
MINNEAPOLIS: Link-Belt Suppl Co.

Tunnel under the C. P. R. R. Station Montreal, is built of Cerestized Concrete

Ceresit Waterproofing is guaranteed as an effective, permanent water repellent for all sorts of concrete construction, such as tunnels, foundations, reservoirs, dams, swimming pools, viaduct, aqueducts, bridges, sewers, water tanks, water towers, cellars, walls, floors, boiler pits and in cement stucco.

Ceresit Waterproofing is a paste which when mixed in the gauging water renders concrete and cement mortar impermeable to water and even dampness.

Beware of imitations claimed to be just as good. Ceresit is sold in packages labeled with our name for identification.

Pits made dry with "Ceresit" Waterproofing

Perth Amboy, N. J., Nov. 29, 1912
Ceresit Waterproofing Co., Chicago, Ill.

Gentlemen—

On the 23rd you inquired from us as to what satisfaction we had obtained from the use of the Ceresit Waterproofing Compound. As you are aware, we have used but a small quantity of this material, but I have a report from our Engineering Department to the effect that it was used on the bosh pit of No. 8 furnace with very satisfactory results. We have previously had considerable trouble with water seeping into this pit, and this compound so far has seemed to eliminate this trouble entirely.

Yours truly,
Raritan Copper Works,
N. W. Pierce, Jr., Purchasing Agent

Ceresit is used in all civilized countries. Ceresit is catalogued in Sweet's Index.

Agents wanted in unoccupied territory.

Ceresit Waterproofing Co. Clark & Adams Sts., Chicago

Branches: 1133 Broadway, New York 1218 Chestnut St., Philadelphia, Pa.

Ceresit factories are located in Chicago; Unna, Westphalia, Germany; London; Paris; Vienna; St. Petersburg

Please cut out this

REMINDER

to write for Free Book "Q" on How to Effectively and Permanently Waterproof Concrete and Cement Mortar.

Ceresit Waterproofing Co.
Clark & Adams Streets, Chicago

ROOFS FOR CONCRETE SILOS.

Perhaps no one article of farm equipment is attracting more attention than the Silo. Almost all types of silos are being built. In the earlier stages it was a mooted question as to covering these silos with roofs. The expense of a roof was considerable. In the cement construction the question of a roof was not only expense but also difficulty in building. It is now universally admitted that silage keeps much better in covered silos. Hence, practically all silos are roofed. To solve the question of expense and convenience of erection a very superior and self-supporting

SHOWING STRENGTH OF JO-BE-CO ROOFS.

galvanized steel roof has been put on the market by the Johnson-Bevington Company, 565 West Washington street, Chicago. For further details, we call attention to their advertisement appearing in this issue. We can recommend this roof to contractors and builders as one of the very best.

CONCRETE PAVEMENTS TAMPED WITH MECHANICAL VIBRATOR.

Concrete pavements, surfaced with crushed granite and compacted to a high density by means of a mechanical vibrator, have been laid in certain cities in Texas. This method of road building was described by Mr. R. D. Stubbs, contracting engineer, of Dallas, in a paper presented at the ninth annual convention of the National Association of Cement Users at Pittsburgh. A summary of the paper is given below.

Concrete is delivered to the subgrade, after it has been properly shaped and rolled, by inclined chutes from a mixer. The proportions are 1 part Portland cement and 5 parts of aggregate, consisting of sharp sand and gravel. The amount of coarse aggregate passing a ¼-in. sieve should not exceed 40 per cent nor be less than 33 per cent. The mix is made rather wet.

The surface is brought to the desired shape by means of long-haired floats, and is immediately covered with a coating of crushed granite, graded from ⅝ to 1¼ in. in size. The surface is then ready for the vibratory treatment. Platforms 20 in. wide, made of ⅝x4-in. strips, cleated ¼ in. apart, are then placed along or across the street and a movable vibrator is rolled over the road, compacting the concrete to high density. As the work progresses the platforms are brought forward and the granite surfacing behind is immediately covered with sharp sand and watered. Two or three days later the sand is swept off the surface into the gutter with stiff wire brooms and the street surface is treated with Tarvia. Upon the Tarvia is spread a coating of hard stone from ¼ to ⅜ in. in size. Upon this surface is spread the sand formerly swept into the gutter. The surface is then rolled with a 500-lb. road roller and after the work is seven days old the street is opened to traffic.

Mr. Stubbs states that he employs no bituminous filled points for the expansion of the pavement, but he does provide for contraction while the concrete is setting by placing on edge on the subgrade at intervals ¼ x 3-in. wooden strips so that these will be buried in the concrete and will occupy the bottom half of the cross section. Within 48 hours after the concrete has been laid, according to Mr. Stubbs, thin, straight lines of relief will appear over the breaker strips. These thin relief lines never exceed 1/16 in. in width. Mr. Stubbs advocates the use of these relief joints only in the case of very dense concrete, but in the case of poured concrete not compacted by vibration he does not favor their use.

UNUSUAL METHOD OF LAYING WOOD FLOOR ON CONCRETE BASE.

In making the plans for the Blake & Johnson factory at Waterville, Conn., the engineers, Griggs & Hunt, Waterbury, Conn., were confronted with the requirement of a 4″ wooden floor on the second story, although the floor panels themselves were to be of reinforced concrete. The usual practice of using nailing strips was at first considered, but there is always danger of dry rot where wood is imbedded in concrete, and protection against dry rot was essential. The method finally adopted was similar to that used under the lower floor in many factory buildings.

For many years it has been the practice of some mill architects where a wooden floor is required directly on the ground, without space beneath, to omit sleepers and bed the plank directly on from 1″ to 2″ of sand mixed with sufficient good, heavy coal tar to fill the voids in the sand. This not only protects the wood against decay caused by dampness from the ground, but the creosote oil in the tar may act to some extent as a wood preservative.

The foundation has often been of concrete, but more often of cinders or broken stone or gravel, mixed with enough tar so it would compact well under a roller and provide a good, level surface for spreading the sand and tar. The mixture of sand and tar provides a perfect bedding for the planks, which are tied together as firmly by the hardwood wearing surface, laid at right angles or diagonally, as a single floor would be by the use of sleepers.

On the second floor of the Blake & Johnson factory, as the foundation (the reinforced slab) was already in, all that was needed was something on which to bed the planks. Sand alone would not answer, as vibration would cause it to shift, but by mixing tar with the sand this danger was overcome. Barrett's subfloor tar No. 5 was used and about 50 gallons mixed with each cubic yard of sand. The mixture was spread on about 1⅛″ thick, so it would compact to 1″, leveled with a straight edge, and while it was still warm and soft the planks were laid on it and tamped until the proper level and stability were obtained. Following the 2″ plank a ⅞″ rough pine board was laid, and then a surface of 1¼″ square-edge maple.

PROFITS IN MODERN BLOCK WORK.

If the concrete block manufacturer wants to prosper, he must secure for his product the indorsement of architects and builders. To accomplish this, he must not only make a hard, waterproof block, but he must produce a block that will be pleasing to the eye and be conformable to the general scheme of architectural design.

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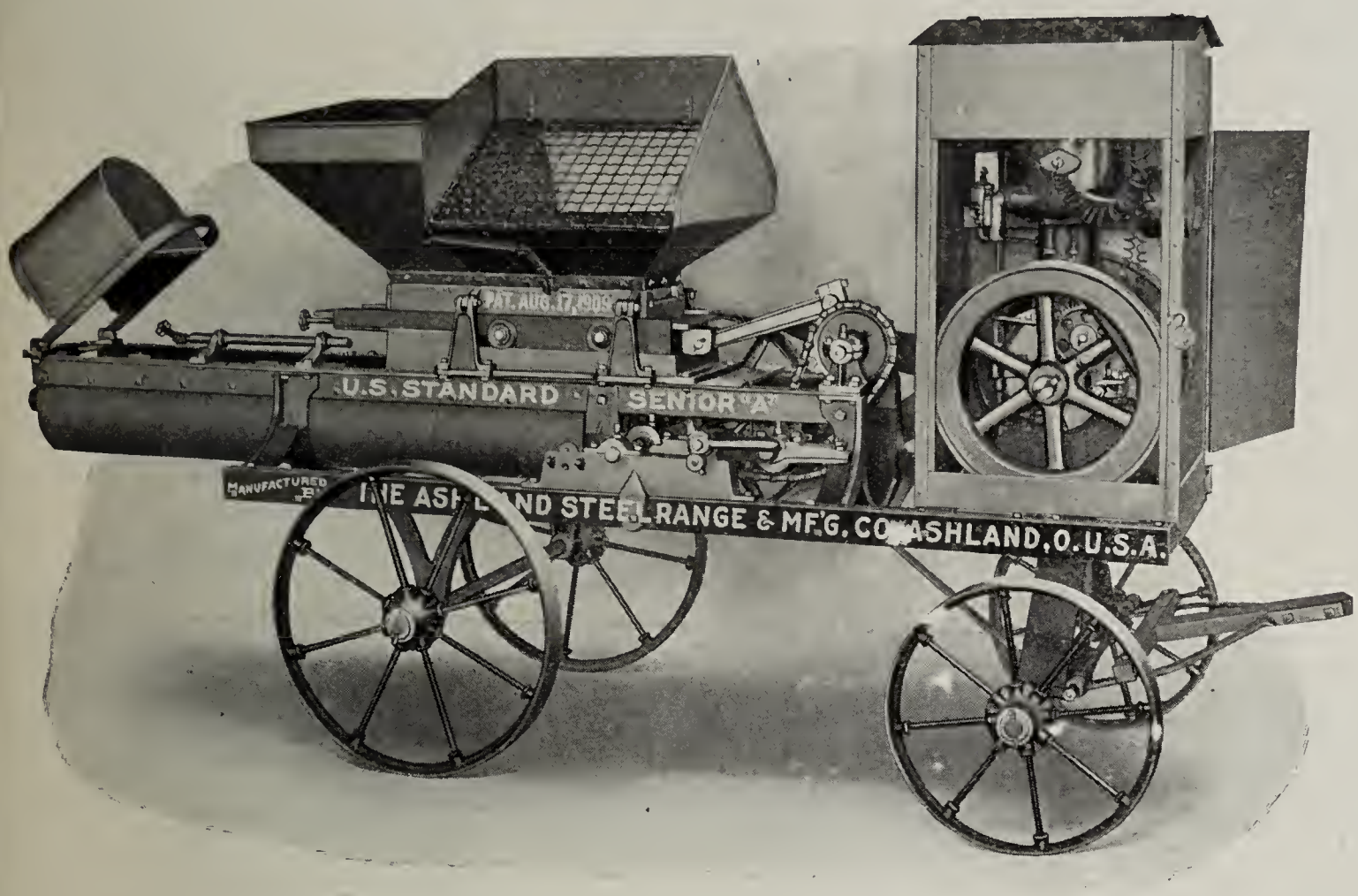

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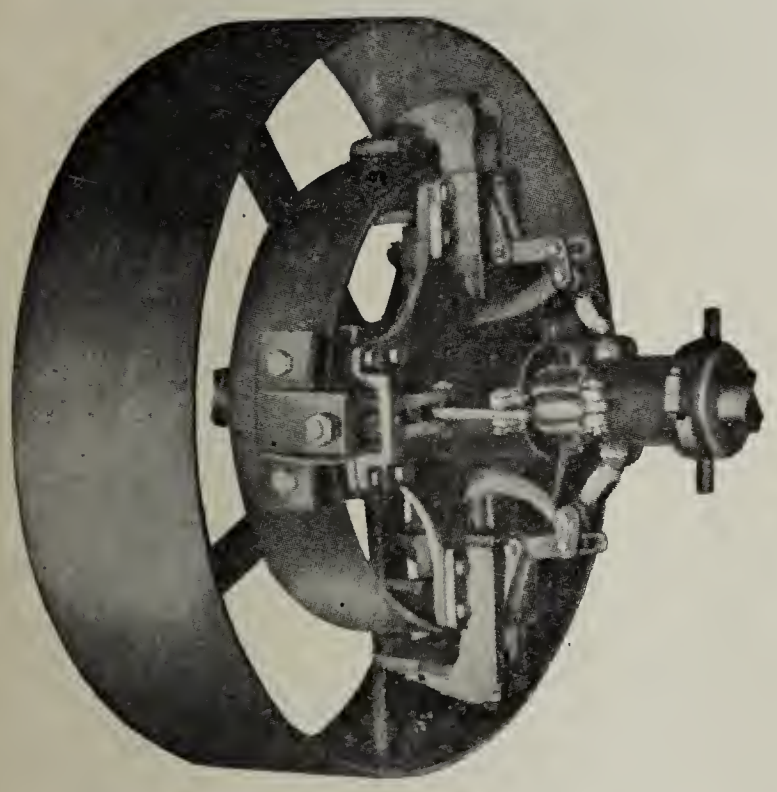

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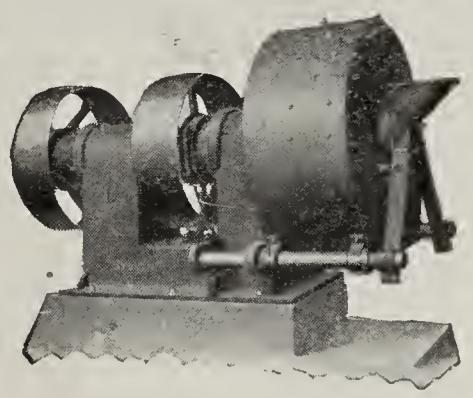

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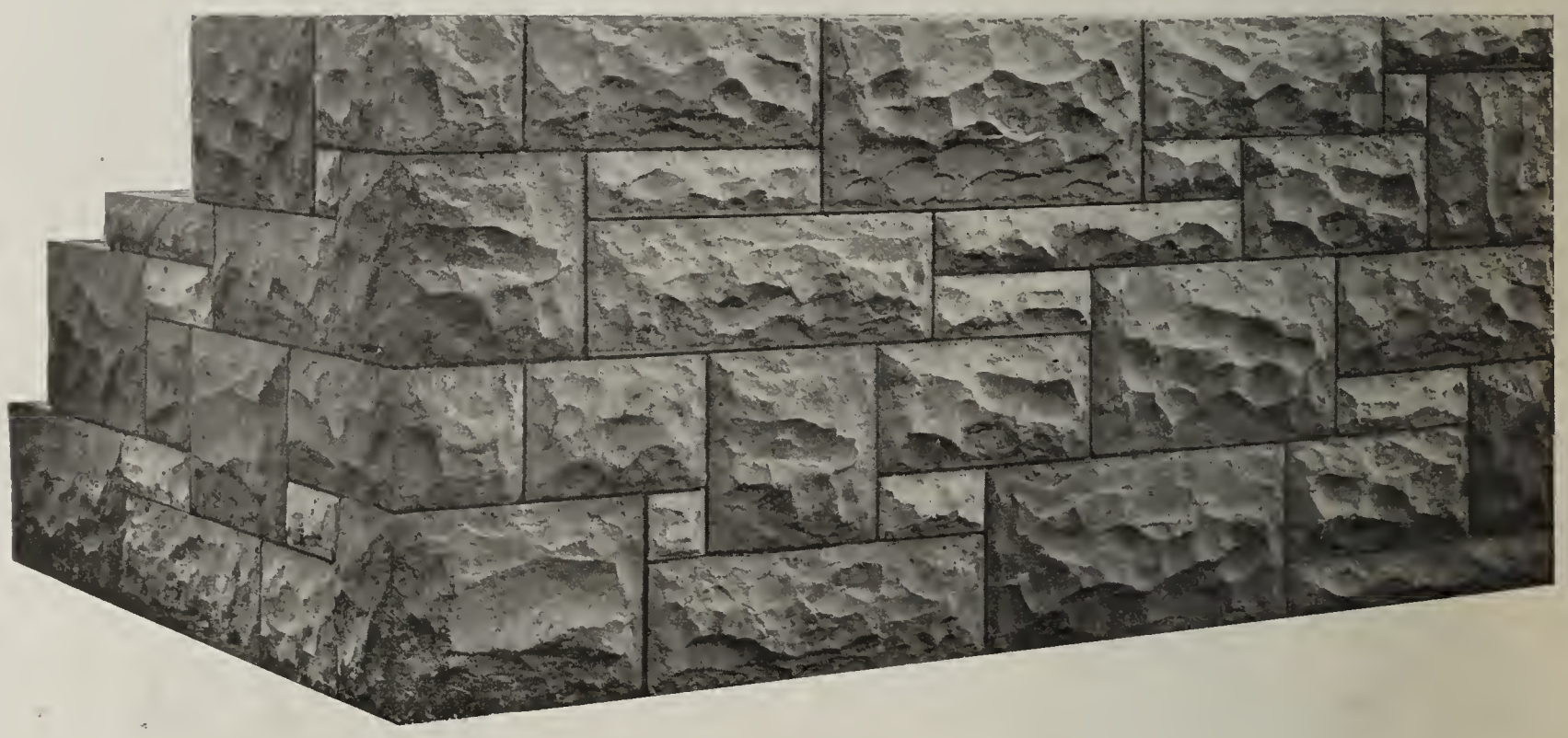
Plain-faced blocks are apt to be cold and uninteresting in appearance, and that is why many people prefer rock-faced work. The rock-faced block, as frequently made, however, is simply intolerable from an artistic or aesthetic standpoint.

This is owing to the use of cast-iron rock-face plates, and to the use of one size and style of block only in an entire building. It is practically impossible for cast-iron rock-face plates to produce a natural rock face. It requires a more plastic material, with which a cast can be taken directly from the natural stone, and then the block tamped face-down on the cast. This cast can be taken even with plaster of Paris, but a composition that is hard and durable is more desirable. Rock-faced block made in this manner go far toward giving natural and pleasing effects. The grain and outline of the pattern stone are not lost, and the result is fine indeed.

If the block so made are laid in alternate courses of different height, or—better still—laid in real broken ashlar, the effect is so much better than the common, monotonous, and artificial looking block work, that the comparison is startling. It must be seen to be fully appreciated. In the view shown herewith real broken ashlar block work made from composition face-plates. Blocks 4, 8, and 12 inches hight, and from 4 to 24 inches long, are used. The 4-inch and the 8-inch high blocks bond with the 12-inch high block, and produce a very strong wall.



If one is properly equipped to do this work, it need cost no more than common work. It will cost, however, about 10 to 15 per cent more to lay.

On the other hand, writes the Hobbs Concrete Machinery Company, who manufacture a special patented block machine for making rock-faced concrete blocks. The block manufacturer will find that this work will please and attract the architects and the best people, and it has been proven that, although produced at only a slight increase in cost over common work, it sells readily for 100 per cent more.

When this broken ashlar work is made and laid carefully, it presents an appearance equal to that of the finest stone masonry. In California, many of the finest churches have been built in this manner.

The progressive block manufacturer in each community who first makes his block on composition plates, and then lays them in real broken ashlar, it is claimed by the advocates of this system, has every chance to reap prosperity beyond his highest expectations.

When broken ashlar becomes better known, it is sure to be popular, and let us hope it will soon displace the unsightly work that has nearly brought concrete block work into disrepute. The Hobbs company will be glad to send their catalog and information to any of our readers.

NEW BOOKS.

TESTING AND SPECIFICATIONS.

Two volumes relative to cement testing and cement specifications have just been published by D. Van Nostrand. One of these is entitled "A Treatise on Cement Specifications," by Jerome Cochran, B. S., C. E., author of "Inspection of Concrete Construction" and other works. The other volume is entitled "A Manual of Cement Testing," by William Allan Richards, B. S., M. E., instructor in the University of Chicago, and Henry Briggs North, D. Sc., associate professor of chemistry in Rutgers College.

The first of these sells at $1.00 and the latter at $1.50. These two volumes parallel each other in so many particulars that one is led to wish that they might have been issued in a single volume.

Mr. Cochran's book is made up almost entirely of suggested paragraphs of specifications. These are arranged under their various headings, such as general conditions covering the use of cement, purchase of cement, delivering and storage, inspection, test, requirements, methods of making tests, chemical analysis, etc. The paragraphs are introduced with side heads in black face, and these together with a most complete index and an extensive bibliography, make the book of value to busy and rapid workers.

The volume by Richards and North has an introductory chapter on classification, composition and manufacture of cement, followed by chapters on sampling and fineness, specific gravity, consistency, strength, laboratory practice, etc.

The volumes run nearly uniform in size and style and are illustrated with drawings. Can be supplied by Cement and Engineering News, 1117 Schiller Bldg., Chicago.

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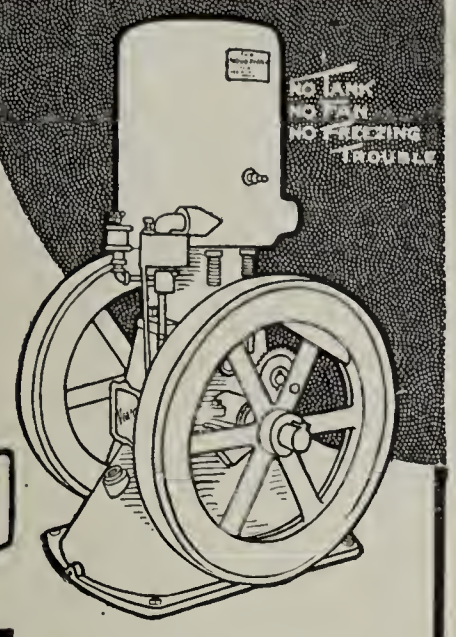

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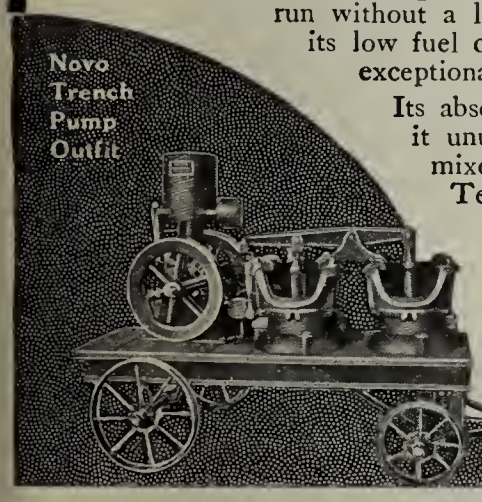

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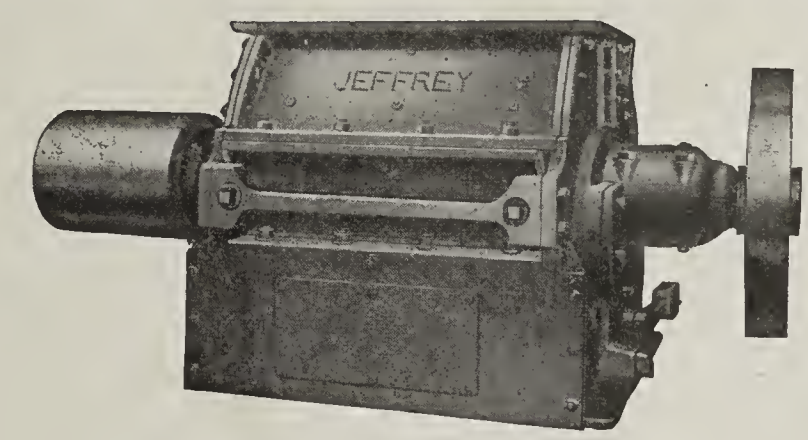

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Cement Mill News

PREVENTION OF MISSED FIRES IN QUARRY BLASTING.

Means of preventing accidents due to missed fires in quarry blasting were discussed by Mr. W. H. Mason, of Stewartsville, N. J., who is superintendent of the Edison Portland Cement Plant, in a paper presented Dec. 5, before the American Society of Mechanical Engineers at its annual meeting in New York City.

Missed holes are always a source of danger, and up to the present time, no safe way of unloading them, Mr. Mason stated, has been discovered. The ordinary method of handling them is to drill a second hole adjacent to the missed one and subsequently shoot them both, the missed hole being exploded by the detonation of the new one. This operation has two distinct disadvantages; first, there is liability of the drill reaching the dynamite in the loaded hole, thereby causing an explosion; secondly, the second shot may throw the explosive from the missed hole out among the debris without exploding it. This is said to occur frequently and unless extreme precautions are used in loading the debris, a chance blow on the dynamite may cause an explosion. It is therefore highly advisable to prevent missed fires entirely, if possible.

As a means of accomplishing this the Edison Portland Cement Company for the past eight years has been exploding all churn drill blast holes with a 500-volt direct-current power circuit. Many of these blasts have included from 12 to 20 holes, each loaded with 500 to 800 lbs. of 40 and 50 per cent gelatine powder, and during this time there has been only one missed hole. On this occasion, it was impossible to find the cause of failure, but it was attributed to a poor connection between the exploder leads and the bus wires. Previously, this company had been using the common push-down batteries, and it was a usual thing to have several missed holes per month. At one of the company's quarries located where no power circuit is available, a 250-volt direct-current generator, driven by a steam turbine, has been installed for setting off blasts and has given entire satisfaction.

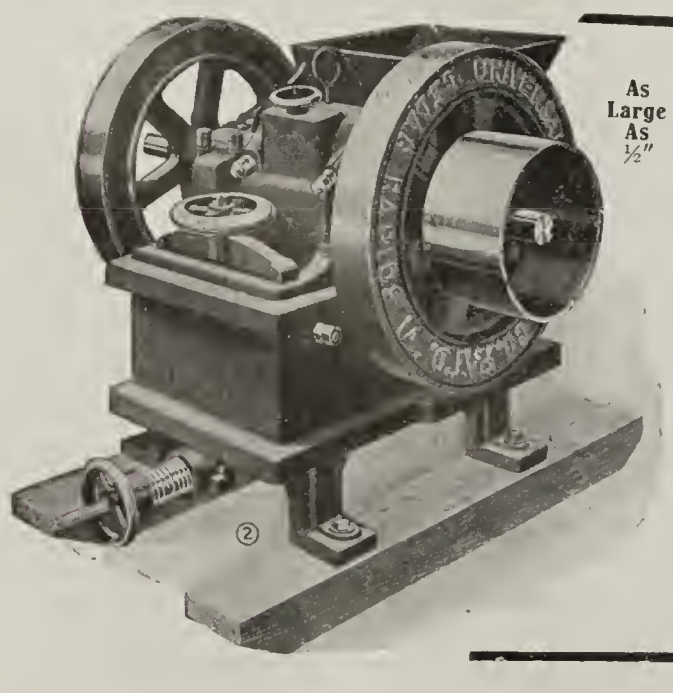
In discussing the use of gelatine powder, Mr. Mason called attention to the fact that it is the most difficult of all the dynamites to detonate, and also that if exploded by a powerful detonator the full effect of the powder is obtained, while if improperly detonated much of the effect is lost. For this reason, and also on account of the danger and expense which always accompany a missed hole, it is well, in his opinion, to use an ample supply of high power exploders. In a 6-inch hole, running 60 feet deep, not less than three exploders should be used. One of these should be directly at the bottom, so that if when loading the hole with dynamite, a stone should slide in from the side and block it off, it would still be possible to explode the dynamite below. The other two are placed one near the center and the other near the top. All are connected directly across the 500-volt or 2,500-volt direct-current line, so that all exploders are in parallel, and receive the full voltage of the power circuit. By this method any number of holes may be exploded at one time.

The cost of the extra exploders is always a small proportion of the cost of the dynamite used, and, in Mr. Mason's opinion, this expense is warranted by the increased detonating power of the exploder, as well as by insurance against missed fires, which are always expensive even aside from their potential danger. Their use has also resulted in greater general efficiency on the part of the workman.

William Volker, 308 West Eighth street, Kansas City, Mo., former treasurer of the Great Western Portland Cement Company, bought the Great Western cement plant at Mildred, Kansas, at receivers sale. The purchase price was $350,000. It is stated that Mr. Volker will straighten out the financial troubles of the concern and place it in operation.

Involuntary bankruptcy proceedings have been filed against the Alabama Portland Cement and Lime Company, Demopolis, Alabama. The company was organized some years ago by British capitalists. M. C. Webb of Demopolis, was named as receiver for the company.

The Dixon Pure Ice Company, Dixon, Ill., has filed suit for $25,000 against the Sandusky Portland Cement Company for damages alleged to have been caused by warm water pumped into the river by the cement company at its factory east of the city. The ice company claims that this heated water will amount to 4,000,000 gallons daily, and that this water during the winter destroyed about 25,000 tons of ice and prevented a profit of $25,000 to the ice company.



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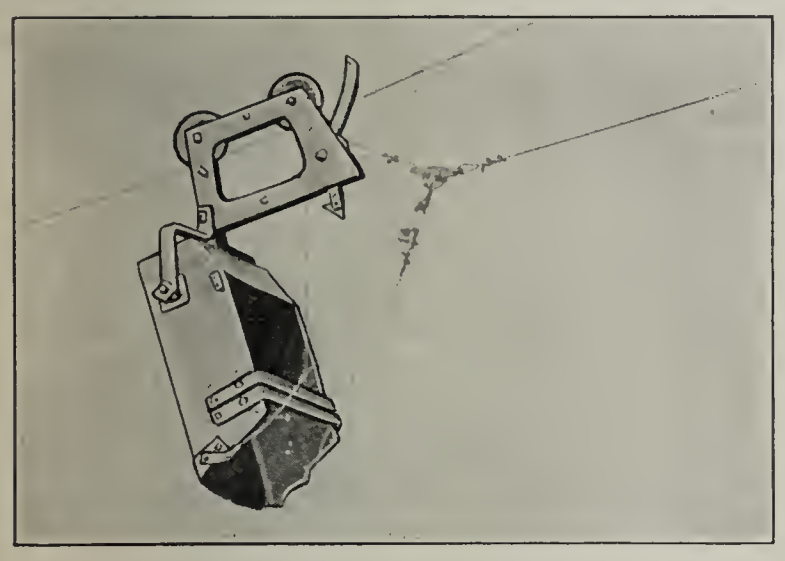

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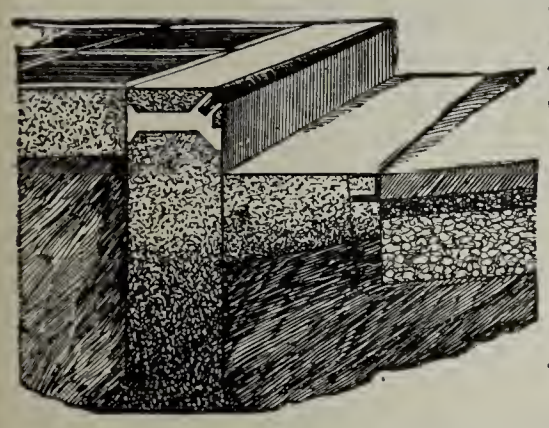

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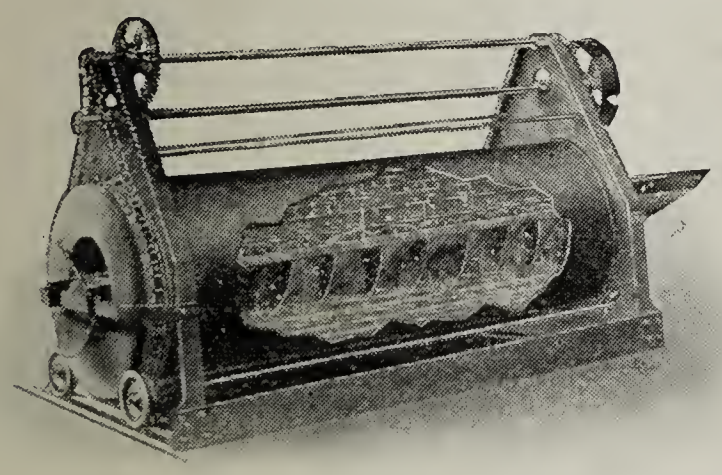

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ANNUAL STOCK HOLDERS MEETING

The Annual Meeting of the stockholders of the Choctaw Portland Cement Works, Hartshorne, Okla., was held April 3. The stockholders were present from Texas, Tennessee, Kansas and Oklahoma. The early part of the morning was spent in inspecting the cement plant and the crushed stone quarry, after which the morning session was held in the office of the plant at ten o'clock. The afternoon session was held in the Owl club room. The entire session was devoted to an effort to devise a plan to raise necessary money to complete and operate one unit of the plant. It was moved and carried that a special proposition be submitted to the stockholders, and that they be given thirty days in which to accept the terms, and if not accepted at that time the directors were authorized to make same proposition to the public. The proposition offered is an unsually good one and it is sincerely hoped that the stockholders will avail themselves of this opportunity to make a good investment, as well as to put their former investment on a paying basis.

The annual report of Mr. C. B. Blake, the President, showed that enough rock and shale was being moved each day to furnish material for one unit of the plant without further cost, and that since the overhead and material cost is already cared for through the operation of the quarry one unit of the cement plant could be operated at extremely low cost per barrel. For the past two years and a half the effort in the quarry has been directed towards getting a long face. Extra steam drills are working night and day and the entire face will be drilled in another two weeks.

Mr. S. Morley was elected President for the ensuing year.

INCREASE IN WAGES AT ATLAS PORTLAND CEMENT PLANT

A general increase in wages goes into effect at the Atlas Portland Cement plant today says the Hannibal, Mo., Journal. This announcement will be hailed with delight, not only by the employes of the big industry which has played such an important part in the growth and development of this city, but by everyone in this entire section of the country.

The increase affects practically the entire force in both of the mammoth plants, five and six. The announcement of the increase in wages, which was made in the pay envelopes of the men yesterday, caused general rejoicing.

The substantial increase in wages indicates that the company is pleased with the loyalty of its great army of employes and is willing to show its appreciation in a substantial way.

This is not all of the good news—five hundred more men are needed by the big industry.

The increase in wages and the increase in the force at the plant means much to this entire section of the country.

CEMENT PRODUCTION IN 1912 IN CANADA.

The statistics of production of cement given herewith, will be subject to but slight variation when complete returns shall have been received. Estimates have had to be made for two firms had not yet reported, but the totals given are probably with a half of one per cent, of the final returns. The record for the past year is of particular interest, in view of the widespread demand for cement. Congestion of freight traffic no doubt militated somewhat against the eastern mills supplying western requirements and in order to relieve the situation the Federal Government reduced the duty one-half on importations during the period from June 12 to October 31, inclusive. Statistically the important features of the industry during the year were an increase of over 26 per cent in the Canadian output, an increase of over 116 per cent in imports and an increase of over 34 per cent in total consumption. Canadian mills supplied 83.2 per cent of the consumption as against 90 per cent in 1911.

The total quantity of Portland cement, including slag cement and natural Portland, made in 1912, was 7,169,184 barrels. The quantity of Canadian cement sold or used was 7,120,787 barrels, valued at the mills at $9,083,216, or an average of $1.27½ per barrel. The total imports of cement were 5,020,446 cwt., equivalent to 1,434,413 barrels of 350 pounds each, and valued at $1,969,529, or an average of $1.37 per barrel. The total consumption of Portland cement, therefore, neglecting a small export of Canadian cement, was approximately 8,555,200 barrels.

ANNUAL MEETING

The adjourned meeting of the Peninsular Portland Cement Company was held at the office of the company in the Cooley block. There was quite a large attendance. The following stockholders attended:

H. F. Stone, Rochester, Mich.; D. C. Griffin, Ypsilanti; H. C. Scovill, Ypsilanti; W. W. Hawley, Huntington, Ind.; J. B. Holthouse, Decatur, Ind.; F. E. Palmer, Neil Cowham, C. F. Cowham, J. W. Shove, all of Jackson, Mich. After the stockholders' meeting the directors met and elected the following officers:

President, F. E. Palmer; vice-president, D. C. Griffin; secretary, J. W. Shove; treasurer, Neil Cowham; general manager, J. W. Shove.

Sacramento—Assemblyman W. A. McDonald's "Cement Dust Bill," requiring the packing of Portland cement in dust-proof packages as a measure of protection to the health of the workmen engaged in handling the product, was reported favorably from the labor and capital committee tonight with several amendments.

The standard of "dustlessness" to be required is that equal to cement packed in paper bags. The bill also was amended to apply only to cement manufactured in California.

Mr. H. Struckmann, general manager of Iola Portland Cement Company, Iola, Kans., has placed contracts for 2—95 C Bucyrus shovels; 4—10x16 Davenport dinkies, and 1—36x60 Fairmount crusher, for the Iola plant. This installation will be followed by the installing of 5—10 feet 0 inches x 185 feet 0 inches Kilns with modern wet grinding equipment consisting of No. 85 Kominuters and large Tubemills.

The Iola company, when this work is completed, will have one of the most modern plants in the country with a capacity of 5,000 barrels a day for the new plant and 4,500 barrels a day for the present 7 feet 6 inches x 125 feet 0 inches Kilns which are now all changed to coal burning and are running very successfully.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, JUNE, 1913

CONCRETE BRIDGES VERSUS STEEL BRIDGES.

The terrible disaster accompanying the floods in Ohio and Indiana has taught the public a lesson in many respects, so that in the future radical changes will take place in construction work as well as in the building of homes all over districts subject to floods.

The most valuable information derived from the damage done is undoubtedly the fact established in hundreds of cases that concrete construction is more lasting than steel construction, and that especially concrete bridges resisted the floods without any serious damage to them, whereas steel bridges were swept off their foundations by the floods owing to the debris piled up against them.

A number of publications, for instance those of the Universal Portland Cement Co. and of the Lehigh Portland Cement Co., describe in a graphic way the "lesson of the floods" and furnish many illustrations of the failures of steel bridges and show cuts of concrete bridges after the flood.

It will certainly be of interest to every consumer of concrete to apply for copies of these publications and to read this literature, as we are able to quote only briefly a number of the most striking paragraphs:

In innumerable instances the immunity of the concrete bridge from destruction proclaimed its permanence and superiority as compared with the bridge built of steel, stone masonry, or wood. We quote as follows from a contribution to the Lehigh booklet from the pen of Mr. Daniel B. Luten, the eminent bridge designer and engineer:

"From March 23 to 27, rain fell to a depth of six to eight inches in Indiana, Ohio, and western Pennsylvania, producing the worst flood that has ever visited that section. Steel and wooden bridges went out by hundreds and thousands. The 'Engineering News' of April 17, 1913, publishes a list of steel highway bridges in Ohio alone that averages 1,000 spans of 100 feet each. Thirty-two steam and interurban railways were put out of service by wrecked bridges.

"Along the Wabash river in Indiana, two steel bridges were wrecked at Peru, six at Logansport, and two at Lafayette, practically destroying all communication across the river at some of these cities, except for concrete bridges at Peru and at Georgetown below Logansport, both of which remained standing. White river, at Indianapolis, wrecked three steel bridges on stone piers and rendered four more impassable."

At Zanesville, Ohio, the reinforced concrete bridge over the Muskingum River, one of the first large concrete bridges erected in the United States, effectively resisted the flood. The only damage was the destruction of the hand rails which apparently had not been reinforced. This bridge and the new Fifth Street bridge at Zanesville were the only ones left standing on the Muskingum River from Dresden, Ohio, to Marietta, a distance of eighty-five miles. The latter bridge was on a higher level than the reinforced con-

crete bridge and had steel center spans and concrete and steel approaches and floors. A reinforced concrete stairway leading to the Fifth Street bridge at Zanesville was left in excellent condition though not built to withstand any great strain. The only damage was a slight injury to the railing. The stairway resisted admirably the pressure of the accumulated debris and the scouring action of the water."

"Peru, Indiana, affords another illustration of how a reinforced concrete bridge offered effectual aid to both life and property. The surge of the flood carried water three feet over the top rail of the bridge and three million feet of lumber was piled against it; yet no damage was done. The bridge was used as soon as the water was low enough to allow people to pass over it and there will be no assessment on the tax payers of Peru for a new bridge."

"The behavior of the reinforced concrete Tennessee Avenue bridge at Ft. Wayne, Indiana, further emphasizes the efficiency of concrete under abnormal conditions. Though the water rose to within a few inches of the arch opening and the structure was subjected to a terrific current and the pressure of masses of debris the bridge remained uninjured."

The experience in the flooded territory has not only justified but has increased public confidence in the permanence of concrete structures. Concrete is a material which is practically everlasting and when proper and reasonable precautions in construction are taken, will withstand fire, flood and storm. Disastrous conflagrations, floods and storms serve to awaken the people to a full understanding of true values in building materials.

Constancy of Volume Accelerated Tests in Portland Cement

At the meeting of the International Association for Testing Materials, amongst the discussions that arose the questions regarding constancy of volume accelerated tests in Portland cement were eagerly discussed. Professor Max Gary, in a paper discussing accelerated tests in Germany states the accelerated test for the volume constancy was discussed as far back as the Zurich meeting of the International Congress for Testing Materials. At that time, Dr. P. Prüssing exhibited samples containing 50 per cent of highly expansive constituents but so finely ground that they slaked readily, without expansion, on being stirred up with a large volume of water, though when mixed with only a little water, for the production of cement ware, considerable expansion occurred. Thus, even at that time, proof existed that a test in which the cement is mixed with much water does not always cast suspicion on such dangerous cements as those in question; and a desire arose for the introduction of some method of testing with specimens made up with only a little water (earth-damp or dry.)

Experiments with various testing methods failed at that time to lead to the desired result; and in the course of time other proposals were made in succession for the rapid testing of cement in order to detect any tendency to expansion. Among these may be mentioned: The Drying test at 100 degrees C. (Darr-probe), the Heintzel ball test (calcination test), the Michaelis boiling test, the Von Tetmajer ball test, the Maclay hot water test and the Prüssing pressed block test.

All these tests met with opposition, and in 1891 the Association of German Portland Cement Manufacturers gave expressions in the following opinions:

(1) The test for standard constancy of volume in Portland cement is sufficiently decisive and perfectly adequate for practical purpose, if performed with care.

(2) The accelerated tests, hitherto published, for ascertaining inconstancy of volume in Portland cement are not adopted to enable the consumer to form a reliable judgment on the cement, it being found that some Portland cements which fail to pass the accelerated tests, prove thoroughly constant in volume when in use.

On the other hand, there were loud expressions of opinion, particularly by Von Tetmajer, Bauschinger, Dr. Michaelis and C. Prüssing, to the effect that the standard tests were insufficient for judging cement, especially when the cement was intended to be exposed to the air during setting in practical use. His opposition to its views induced the association to appoint a committee entrusted with the solution of the following question:

Does the standard test for constancy of volume in Portland cement enable an accurate judgment to be formed on the behavior of a cement in use, or is this object attained in a more reliable manner by any of the proposed (accelerated) tests?

Without delay, the committee began operations in collaboration with the Royal Mechanico-Technical Laboratory at Charlottenburg. The laboratory procured ten cements which, according to the users, had behaved satisfactorily in practice, though failing to pass the boiling test. All the cements were tested by the laboratory and by the members of the committee separately, as regarded their general properties, changes of volume in the Bauschinger tester, tensile strength and behavior under the above mentioned tests for constancy of volume. Morever, reliefs and conduit covers were made from the cements at the cement works for the purpose of being exposed to the air, subject to all changes in the weather during setting.

It is impossible here to go into the details of the experiments, but it must be specially mentioned that none of the so-called "accelerated" testing methods tried (drying test at 100 degrees, Heintzel ball test, Von Tetmajer ball test, Maclay hot water test and Prüssing pressed block test) appeared calculated to enable a rapid and reliable judgment to be formed in all cases as to the suitability of a cement for practical use.

The experiments showed that all ten cements which passed the standard test also exhibited constancy of volume (in the practical sense) when used for making test pieces and cement ware. The practical utility of the cements was also demonstrated by the increased tensile strength of the test pieces when allowed to harden in water and in the air.

The assumption that the standard test for judging a cement is inadequate, especially when the cement is intended, in practice, to harden in the air, failed, therefore, to obtain any conformation through the experiments of the committee. That body, however, expressed its willingness to carry out additional experiments, and publicity requested the adherents of the accelerated methods of testing to place at its disposal sufficient quantities of such cements as passed the standard test, but failed to pass the accelerated tests and were found to expand in practice. Cements of this kind were to be forwarded to the Charlottenburg laboratory. In spite of the long term appointed, no response has been received on this matter by the laboratory, and no experimental material for testing in the above-mentioned manner has been furnished.

This might have been considered as settling the matter; but the laboratory had gone further, and has continued for years to keep under observation the cements (and the articles made therefrom) characterized as highly suspicious from the results of the accelerated tests without, however, finding any alteration in the result.

Accordingly, the assumption that the so-called accelerated tests for constancy of volume enable, in general, a more accurate judgment to be formed on the suitability of a cement than is done by the standard test should be dismissed as erroneous. Following on the experiments, however, the laboratory requested a large number of officials to keep under observation the constructional works carried out by them with cements which, according to the accelerated tests, ought to be of suspicious character; and the results of such observations have been compared with the results of the accelerated tests on constancy of volume. This comparison established in an unimpeachable manner that numerous cements of different origin and methods of preparation, which had partially or entirely failed to pass the accelerated tests for constancy of volume, were found to have fulfilled their purpose completely, irrespective of the conditions of the mixtures, during an observation period of 34 to 18

months, without giving rise to the smallest objection in connection with their constancy of volume.

Furthermore, it has been established by a circular inquiry among more than 200 users of cement that the dubious value of the darrprobe and boiling test in particular has already been recognized in practice, and that there is no longer any need for such tests. In numerous instances it was found that testing in the standard manner sufficed completely to reveal the inferiority of a badly prepared cement. Six cements, which, on the basis of the boiling test and drying test at 100 degrees C. ought to have ranked as quite useless, have been employed, officially, for a variety of building purposes, e.g., in building a fire station; for concrete and masonry in harbor work; in abutments and circumvalliation work in a fortress; in building a high level water tank; in the piers of a large railway bridge; for concrete floors and ceilings, etc. In all cases the work has remained under observation for several years, but in no case, however, has the work given rise to complaint on the score of changes in volume, or in any other respect, although the constancy of volume of all these cements, as determined by the darrprobe, calcination test and boiling test, was open to the gravest suspicion, and although remarkable phenomena were exhibited at the end of one and two years by the test blocks in air and water. No injurious effect could be observed in practice—in a very thick concrete wall—even in the case of a cement which was completely disintegrated by the boiling test, and showed reticulated and edge cracks at the end of two years in a test block immersed in water. The thoroughness of these observations and determinations is probably unsurpassed.

After the publication of these results the question of accelerated tests for constancy of volume slumbered for some years, so far as Germany was concerned, until Le Chatelier proposed to fill the cement paste into split brass rings fitted with needles and test the expansion by measuring the distance between the needle points after treatment in hot water. Hence the Le Chatelier test is an improved form of boiling test.

Quite recently Dr. G. Hentschel has proposed a modified boiling test for cement. Instead of performing the boiling test after the block has been hardened for 24 hours, he proposes a preliminary treatment to accelerate the hardening before applying the test. The block is to be left for 15 to 20 minutes on a highly absorbent gypsum plate, and then be heated, on an iron plate, over a naked flame until no more water vapor is given off. After cooling, it is immersed for 10 minutes in water at room temperature, and is then exposed to the air for three hours, being finally boiled. It should be remarked that one cannot expect this test to furnish any essentially different information from that given by the old darrprobe and boiling test; and it will prove unreliable and misleading for the same reasons as the older tests.

Greater attention was bestowed on the Le Chatelier test, mainly because, in contrast to the other methods, it furnished values which were regarded as mutually comparable. The British Standard Committee took up the Le Chatelier test; and from England this test was laid before the International Association and caused to be accepted by the Copenhagen Congress, 1909, as a commendable accelerated test for constancy of volume, although a number of expert members protested against this decision. The protest was entered in the minutes of proceedings, and is now brought to remembrance again.

In justification of this protest, reference was made at Copenhagen to the aforesaid unfavorable experiences with the boiling test. It must be reiterated that the Le Chatelier test is a boiling test, and therefore must also be judged, like the old boiling test, on the basis of the comprehensive experiments already referred to. Moreover, it is necessary to point out the opinion in which this test is held even in England.

At a meeting of the Concrete Institute in 1910, Mr. Butler read a paper on tests for constancy of volume, which paper was followed by an extremely animated discussion. The reader of the paper supplemented a historical review of the development of the existing tests by an exposition of the theoretical advantages of the Le Chatelier test; but on the basis of many thousand experiments with the Le Chatelier needle came to the conclusion that, owing to the often contradictory results in cases where the cements would have to be condemned on account of failure to pass the Le Chatelier test, the results must not be interpreted too strictly. He also demonstrated that divergent results could be obtained in different localities, and that the results also differed even when the tests were performed at one and the same place and under perfectly identical conditions. It is highly interesting and characteristic of the lack of practical value of the test that the results of Butler's experiments entirely coincide with the experiments (to be mentioned later) carried out by the Association of German Portland Cement Manufacturers. Butler found:

In the first place, that with three operators working in the same place and with the same molds, the results of the tests showed extreme divergences. One operator found considerable expansion of the cement, whilst the other two found much less expansion. According to the result of the one test, the cement would have to be discarded as not being constant in volume; whereas, on the basis of the results obtained by the other two, under precisely equal conditions, the cement was not open to objection.

In the second place, Butler found that an extraordinary influence on the results was exerted by the use of different kinds of needles, whether brass or copper, old or new.

Thirdly, he found that on many occasions the test pieces gave higher expansion values after the cement had been exposed to the air for 24 hours or 6 days than when the same cement was used in the original conditions. He points out that, in the English method, the expansion during the first 24 hours—which in many cases is far greater than the subsequent expansion—is entirely neglected by the boiling test, and that leaving the cement 24 hours before boiling is quite an arbitrary procedure.

At the conclusion of the paper, the author said that, whatever good reasons might exist, either in favor of or against accelerated tests for constancy of volume, he could vouch, from his personal experience, for the fact that not 90 per cent of the Portland cement made in England or elsewhere less than 20 years ago would have been able to pass the boiling test under the conditions laid down. If this test were indeed an accurate one for constancy of volume, the evident conclusion would be that 90 per cent of the total cement used 20 years ago was not constant in volume. This would be a somewhat surprising assumption when it was remembered that hundreds of thousands of tons had been used for important structures in different parts of the world; and in view of the excellent present condition of these structures, the assumption could not be seriously brought forward.

This paper was read at a meeting under the chairmanship of Mr. Blount, the advocate of the Le Chatelier test at Copenhagen. Mr. Blount's criticism of

the paper was that he did not agree with Mr. Butler. This terse but unfortunately, merely ex parte opinion was, however, not shared by a large number of well known English cement manufacturers, who expressed their agreement with Mr. Butler. Among others, objections were raised against the Le Chatalier test by Messrs. Bamber, Cooper, Tristam, Watson and Roberts.

So far as the Association of German Portland Cement Manufacturers is concerned, the Le Chatelier test was first tried, in 1909, by a special committee, under the chairmanship of Director Schindler. It appears from the comprehensive report that, as was found by Butler, there was no harmony between the results obtained at different testing stations. The experiments were continued, on a larger scale, in 1910 with six cements. The results were most contradictory, one and the same cement giving expansions varying between 0 and 10.7 mm. of needle divergence at different stations. Schindler's report contains all the individual values and careful drawings of the results at ten testing stations.

At the Royal Laboratory for Testing Materials, experiments were carried out in 1911 with six Le Chatelier needles, of different kinds of brass and copper, and the experiments, like those of Butler, show that the results of the Le Chatelier test vary according to the kind of material and method of making the needles.

Consequently, the apparatus is, in itself, uncertain and unreliable.

Finally, under the chairmanship of Dr. Strebel, committee No. V. of the German Association for Testing Materials, made a thorough investigation of the Le Chatelier test, and Dr. Strebel presented his report to the twelfth general meeting of that association held in Düsseldorf on October 7, 1911.

The experiments led to the following conclusions:

(1) It has been found that the Le Chatelier test characterized as constant in volume a cement which exhibited a decided tendency to expansion in cold water. Even if the cement in question be one of abnormal composition, it was, nevertheless, bought in the open market; and consequently the buyer of such cement would, if he relied on the results of the Le Chatelier test, have incurred risks by using the cement in practice.

(2) It was also found that the results obtained in testing one and the same cement in different testing stations varied in such a manner that in quite a number of instances a cement would pass the test in some stations but not in others. The risks arising from such unreliability on the part of an extremely important test do not need to be enlarged upon. The matter is rendered more serious by the fact that the tests in question were performed by skilled operators exclusively, and in strict accordance with the prescribed conditions.

Owing to the coincidence of these results with all those obtained in the previous experiments, the committee—comprising not only manufacturers, but also a large number of the most prominent cement experts in Germany—decided to invite the German association to adopt the following resolutions:

(1) The German Association for Testing Materials rejects the Le Chatelier test as an accelerated test for constancy of volume.

(2) The Association requests the International Association for Testing Materials to set aside the resolutions adopted at Copenhagen with reference to the Le Chatelier test.

At Copenhagen it was evident that the German cement industry would have to fight shy of the introduction of the Le Chatelier test, and that the resistance offered to this test by the German members was based on that circumstance. On the other hand, it should be mentioned that already in 1909 experiments with the Le Chatelier test were carried out in the laboratory of the Association of German Portland Cement Manufacturers, as reported by Dr. Framm in 1910. According to the English regulations, the expansion of the test pieces (cement not exposed to air) should not exceed 10 mm. after six hours' boiling. This condition was fulfilled by 83 samples out of 88 German commercial cements, originating from 88 different makers, 79 of the samples giving an expansion of less than 5 mm. and only 4 samples one, between 5 and 10 mm. The mean expansion of the entire set of samples, including those which failed to pass the test was only 3.5 mm. This shows that if the Le Chatelier test gave reliable results, the Germans need not fear its introduction. It is, however, rejected because the result of the test is uncertain and bears no relation to the other properties of the cement.

Basing on the foregoing unassailable facts, I arrive at the following conclusions:

The decision of the Copenhagen Congress to commend the Le Chatelier test as accelerated test for constancy of volume is not borne out by the facts of the case. The Le Chatelier test is misleading and should therefore be discarded.

F. T. CROWE BUILDING MATERIAL CO., SPOKANE, WASH., WILL COMPETE WITH SAND AND GRAVEL CONCERNS.

According to current information there has been in the city for a long time what is described as a sand and gravel combine, whereby the dealers in that product have arranged a scale of prices and have been able to dictate to the contractors. Many of the contractors have brought sand and gravel a long distance in the past, says the Spokane Chronicle.

"The Crowe company will undoubtedly operate independently," said A. K. Copson, contractor, this morning. "It will probably mean a big fight when building operations open up in the spring. A combine in this line has been in existence here for some time, and the entry of the new firm into the field will probably be hailed as a good thing."

Secured Options.

Thomas S. Bush, local manager of the Crowe Company, when seen this morning said:

"We have secured options in several parts of the town, all within the city limits, which will enable us to go into the business on the same scale as we have undertaken our cement department.

"We shall be able to put it in all parts of the city readily, and handle the business in a thoroughly practicable way. We have for two years been planning for the white sand trade, and the new departure will include this with the sand, gravel and crushed rock. White sand for plastering and glass manufacture will be shipped by us all over this section from here to the coast.

"We shall operate the new department on the same scale as our cement where we handle not only the domestic Portland cements, but also French and German imported cements, pure white Portland, waterproofing cement and cement paint, Atlas, Medusa bricklayers' cement and the anti-freezing variety."

The Specialist Constructor of Reinforced Concrete

The reinforced concrete specialist, or more precisely, the engineering constructor who deals in the design and construction of reinforced concrete structures, has gained great prominence in America. America does not stand alone in this regard. In England there has been quite as pronounced if not so great a growth of the reinforced concrete specialist. Just now English engineers are discussing the proper position of these specialists in the engineering field and this discussion is so well presented in a paper by Mr. Lucian Serraillier in Concrete and Constructional Engineering that we reprint the paper here as follows:

The reinforced concrete specialist, a product of the last 20 years in this country, is the logical outcome of conditions which must necessarily arise from the introduction not of a new branch of engineering, but of a new material and method of construction which is applicable to the whole range of engineering and architectural work. And herein lies his raison d'être, for he has come not to oust the profesional engineer or architect from his legitimate work, but to act as his ally. The architects sphere is still the design of beautiful and appropriate buildings, and his reliance upon the specialist for the structural portion of the work is but the continuation of the policy he has followed in the past of reliance upon the structural steel specialist for the design and calculation of the girders, joists, stanchions, a form of construction which is now being rapidly superseded by reinforced concrete. It is this intimate association between art and science, between architect and specialist, which appears likely in the next few years completely to revolutionize our buildings, both in external appearance and internal disposition.

Reinforced concrete has possibilities, structural, artistic and economic, which far exceed any possessed by steel construction. We have long since reached the limitations of the latter, whereas the economic and structural advantages of reinforced concrete are only now being borne in upon us, and we are but on the threshold of what may be accomplished in the outward expression by form and color of this raw material. Here is the architect's opportunity, and far from a conflict of interests between him and the specialist, we discover rather a community of interests in the design and execution of structures which combine beauty with utility and practicability.

It is, of course, quite customary to specialize in engineering work. The engineer, after a general training and experience, frequently confines his activities as an expert to dock or railway work to sewerage, waterworks or other of the many branches in the whole range of engineering practice. This practice is also immune from the intrusion of the reinforced concrete specialist, who does not encroach upon any of these departments, but merely specializes upon what may become an adjunct common to all these branches. his function being merely to apply a new material to all classes of construction. The specialist, for instance, will design a reservoir, but does not profess to scheme out the water supply of a community, which is strictly within the province of the water engineer whilst that of the specialist in this instance is to apply his knowledge to merely part of the general scheme. And so on with every class of engineering structures. For instance, the consulting engineer of a trading concern has to deal with the water supply, the lighting and ventilation and erection of machinery, as well as the construction of buildings. He must perforce consult these high specialized branches of engineering, and there is no reason why he should not in like manner employ the services of a reinforced concrete specialist for the structural part of the enterprise. Thus we again possess all the elements of an alliance instead of a conflict of interests between engineer and reinforced concrete specialist, which certainly permits the former to consult the latter without derogation to his professional status. The function of the engineer may well be the co-ordination of the knowledge and experience of these various specialists rather than an attempt to know in detail every branch of engineering, an attempt which must necessarily fail.

The specialist, however, is still regarded by many as an intruder, and when he combines with the offer of his designing knowledge and experience the sale of some reinforcing material he is apt to be considered in the light of an iron monger. But these prejudices, arising chiefly from ignorance of the true function of the specialist, are rapidly disappearing, if one may judge by the amount of work which is now flowing into the offices of the various specialists firms established in this country.

There can be no two opinions as to the indebtedness of the community to the specialist firms who have been responsible for the introduction of reinforced concrete into this country. Had it not been for them the natural conservatism of both engineering and architectural professions would have delayed matters for many years. Experiments are costly, especially in civil engineering, where everything is on a large scale, and the very natural attitude of the profession, which has everything to lose in the way of reputation and practice by the introduction of an untried form of construction, was one of caution and maintenance along lines of proved safety. The question naturally arose, who is to be responsible for work done in accordance with this new method of construction? The specialist stepped bravely into the breach and backed his opinions by deeds, by the acceptance of financial responsibility. One may well lay stress upon this point, because the specialist has in most cases been criticised for confining the permission of constructing on his designs to a limited number of contractors, and thereby restricting competition. Such action was quite natural at the outset as a protection against a financial responsibility thrust upon him which no private professional firm would accept. This security was assured by restriction to a few approved contractors experienced in carrying out his designs, and, however obnoxious such an approach to a trust may be to the average Englishman, there is no doubt this wise policy has prevented disasters which would have retarded the industry for many years.

This limitation of contractors is now not only tending to disappear, but bids fair to drift to the other extreme, a system of unrestricted competition, with which it is now proposed to deal.

The opportunities of the advent of the specialist and the services he is able to render to both professions will probably be generally admitted. The manner in which such services may best be utilized to mutual advantage is however, a matter of some contention.

Briefly, two classes of reinforced concrete spec-

ialist firms exist: those which exploit patent systems, and those which sell patent bars and reinforcing material. The former derive their profit by charging a percentage on the value of a contract for their professional services, the latter by charging such a price for the bars they sell as will afford a profit equivalent to the percentage they also require for their professional services. This article does not purpose to deal with the relative merits and disadvantages of these two methods; each has its camp of adherents, but that they both render services is testified by the increasing work which is placed with them. This divergence is negligible, and is principally a matter of slight difference in name. What is of importance is what is the best way in which to take advantage of the services offered by either class of specialist.

The general practice for the engineer or architect who has a scheme to be designed in reinforced concrete is to invite tenders from all and sundry, under the first impression that an open competition will produce the best economic and structural results. With the object of obtaining the best work at the cheapest price, leading systems are invited, and each system has its array of contractors; in some cases the same contractor may tender on different designs from two or more competing specialist firms. It appears, however, that this object is not achieved, for in the first place it is generally difficult to adjudge the contract to any other than the cheapest tender, which is no criterion that the best design, which is of primary importance, has been attained. Nor is the successful tender necessarily as economical as it might have been, for it certainly does not follow that the cheapest tender accepted could not have been cheaper had the same contractor tendered on the best design if the latter had been selected beforehand.

The element of chance enters too largely here, for the specialist firm which has submitted the best design may have been unlucky in the tenders of their contractors.

Again, the specialists who are invited to submit designs in competition with one another are all doing the same work, in which only one can be successful. The non-successful ones, therefore, are losing time and money. Specialists must live, and since they thrive, it stands to reason that they must make good their loss in one direction by profits in another—that is, on jobs in which they are successful.

This remark applies equally to contractors, and, in fact, to all competitive work which is carried to an extreme. The problem is to strike a happy mean between indiscriminate and unrestricted competition and privileged monopoly. The mistake lies in mixing up the question of design with the question of tender.

The remedy is to select the specialist firm and system to be adopted and arrange their fee beforehand; or, if competition of design is desired, let it be limited to two or three specialist firms instead of allowing a job to be hawked about, which has a discouraging effect in the long run on competing firms. Having selected the design, the client should then, and only then, invite tenders from contractors on a proper bill of quantities. It is a well known fact that there is very little difference between the well-considered designs of various specialists for the same structure. The question of price, therefore depends very largely upon the contractors, and it is conceivable that the best and most economical design may have been discarded because the tenders upon it happen to be too high. The tenders from one contractor on several competing designs for the same job do not show anything like the variations in prices that is shown by the tenders from several contractors on the same design. Hence the proper procedure is to select the design first, and then invite tenders upon it, instead of jumbling up the two essentially different processes as at present.

Another opportunity for improvement lies in extension of time for the preparation of plans. As a rule the time given is too short, and the result is hasty work which may contain mistakes which lead to friction between client, specialist and contractor. Too little consideration by a client is generally shown on this point, and the practice, hardly consecrated by justice or crowned by success, of attempting to hold the specialist responsible for the accuracy of the quantities of concrete and steel, does not conduce to economy; for the specialist, if pressed for time, will generally err on the generous side of his quantities rather than run the risk of having to make good out of his own pocket the deficiency due to under-estimating. Here, again, the client pays in the long run.

The method of payment to the specialist also leaves much to be desired. It should be made direct by the client, and not through the intermediary of the contractor. The specialist is selling his services, and this has nothing to do with the financial stability of the contractor, upon whose selection he generally has very little to say. For the contractor to pay the specialist is to deprive the latter of the control he should, on the contrary, hold over him. This consideration brings one to a recent departure which has occured in the contracting world. Some contracting firms have recently joined the ranks of specialists by organizing a designing department in conjunction with their ordinary business as contractors, such departments being generally run by engineers who have acquired their experience among the original specialist firms. Such an arrangement is not desirable, since it attempts to assimilate two separate elements—execution and supervision. It is difficult to conceive how it can benefit any but the contracting firms in question, whilst from the client's point of view it is absolutely disadvantageous. The position of a contractor who tenders on his own design is anomalous. The prime object of a contractor is to obtain the contract, and he knows that price tells. The necessity of control, is, therefore, all the more imperative, when as in this case, there is a temptation to cut things fine. For whether the client be professional or otherwise, the fact that he invites designs from a specialist implies a certain ignorance of the subject which, in the case of such a highly specialized subject as reinforced concrete, is not derogatory to his professional capacity, as has already been pointed out, but which undoubtedly weakens his control over the actual construction, if the designs have been prepared by the contractor. In the method suggested, whereby the specialist is first selected, the necessary control over the executors of the work—that is, over the contractor—is either shared by client or specialist, or at least delegated by the former, who still retains the ultimate power, to the latter. There is no doubt that suitable provision should be made for supervision of a reinforced concrete contract by the specialist, but when the contractor is his own specialist and supervisor he is beyond control and criticism, and the position becomes not only illogical but extremely dangerous.

Considerable expense on the part of specialists would be saved if clients would only limit their invitations for designs and tenders to jobs which are practically certain to mature. The nebulous schemes which are presented to the poor specialist—schemes which have the most slender chances of materializa-

tion—only go to swell the expenses of those firms, who must necessarily recoup themselves for this loss by increased profits in other directions.

The attitude of the local government board on the subject of reinforced concrete is both incomprehensible and illogical. Every other government department has recognized this new form of construction. Despite the numerous public buildings which are being erected everywhere, despite the proof of solidity, economy, durability and reliability which has been shown by reinforced concrete in structures which have stood the test of a quarter of a century, the L. G. B. generally refuses to authorize loans on the same terms as masonry or even timber structures. Reinforced concrete, it would appear, is still in the experimental stage, and the attitude of the L. G. B. remains early victorian. Time, of course, is the solution; the younger generation of advisers cannot fail to give reinforced concrete the same recognition it has received in all other quarters—commercial, professional and official. The long-suffering tax-payer is consequently called upon to pay for the more expensive forms of construction in the case of nearly every job in the country which is brought to an untimely end by the too stringent financial conditions of the L. G. B.

The future of the industry is, however, full of promise. A more thorough acquaintance on the part of the public with the conditions which surround the business of the specialist cannot fail to improve these conditions, possibly on the lines which have been briefly indicated in this article; and the attitude of a government department, based on obsolete traditions, cannot long continue to hamper the development of a form of construction which has received universal recognition.

EFFECT OF MOISTURE ON THE STRENGTH OF CONCRETE: AN EXPLANATION OF CONCRETE DRAIN TILE FAILURES.

A study of the existing literature on mortars and concrete seems to indicate that the factors affecting their strength are fairly well understood. Many reports are available of exhaustive investigations as to the variations in the strength of concrete resulting from varying proportions of aggregate, age and quality of cement, varying sizes and quality of aggregate, different methods of mixing and curing, different methods of testing, and of various impurities in the mixing water or aggregate, writes Sherwood M. Woodward and Frederick C. Young, of Iowa City, Ia., under date of February 10, 1913.

To make the assertion that after it has set the amount of moisture present in a portland cement concrete has an effect upon its strength of sufficient amount to be of practical importance in some uses of concrete, and that this fact is not recognized in concrete literature may astonish, yet investigations recently made seem to indicate that such is the case. When we consider, however, that only within the past two years has it become an established fact that concrete expands and contracts with changes in the amount of moisture present just as wood does, it does not seem altogether impossible that we have been overlooking such a simple thing as the fact that the presence of water materially affects the strength of concrete.

Several failures of concrete drain tile in the state of Iowa have caused concern, and various ways of testing tile have been proposed. But not infrequently large numbers of concrete drain tile fail after being laid and covered, notwithstanding the fact that every joint is tested before laying and withstands a larger load than they are subjected to in the ditch. The significant fact about the failures is that they all seem to occur within a few hours after laying, but not immediately after covering. All joints that withstand the earth pressure for, say, twelve hours, prove to be permanently safe, even though the depth of covering is afterward increased. It was thought that the explanation of this action might be that the tile are tested in a fairly dry condition, and that the moisture which soon saturates the walls after the tile are laid in some way has a weakening effect. It was at first thought that the weakening must be due to some sort of chemical action.

To learn whether or not this is the explanation, experiments were begun in the testing laboratory of the College of Applied Science, State University of Iowa, about a year ago. It was soon proved that a 1-3 portland cement mortar cured in air under conditions similar to those commonly obtained in the manufacture of cement drain tile, was weakened from 40 to 50 per cent by being soaked in water. It was further proved that this weakening resulted at once, that is, the full weakening effect came about just as soon as the specimens were saturated with water. This fact seemed to indicate that the cause was physical and not chemical.

Many questions immediately arose. How does this weakening vary with different mixtures, with different cements, with different methods of curing? Is the percentage of weakening proportional to the moisture content? Can the mortar be repeatedly weakened and strengthened by repeated wetting and drying? A series of experiments is under way for the purpose of answering some or all of these questions and the results will be published when obtained. The mere fact, however, that a dry mortar may be weakened 50 per cent by the introduction of pure water seems of sufficient importance to warrant its publication at this time. While it is true that a greater part of the concrete made is used in large masses with a sufficient factor of safety to cover such variations, yet the fact remains that if the factor of safety is based upon a strength obtained experimentally upon a dry concrete, it may be reduced 50 per cent by a wetting of the structure. Furthermore, in cases where concrete is used in thin walls subject to bending without reinforcement, such as in drain tile, this weakening may actually cause failure as in the instances cited.

It has long been recognized that the strength of wood varies with the moisture content and tables of ultimate strengths of wood are always based upon a known percentage of moisture present. In view of the above facts, is it not equally important that reports of tests of strength of concretes and mortars contain a statement of the condition of the specimens with respect to moisture content?

NEW BOOK ON ROCK DRILLING

Rock Drilling. By R. T. Dana and W. L. Saunders. Pp. 319; ill., index. For sale by Cement & Engineering News, 1117 Schiller Bldg., Chicago. Price $4.

Following a general introductory statement covering blasting and explosives, this volume treats in detail the methods and costs of open-cut excavation and submarine rock-drilling. It is based principally on material collected and compiled by engineers of the Construction Service Company, and includes accurate records of cost and drill duty in many kinds of work. Diagrams and tables are freely used in such shape as to make more than a mere record of cost. Accurate comparisons and analyses become easy. The book is well written and well illustrated and is sure to prove of large value to consulting and constructing engineers.

Safety in Concrete Construction

It has occurred to the writer that a short review of the structural iron and steel industry, touching on its growth in this country from a period of ignorance and uncertainty to its present state of near-perfection and security, and a comparison of this condition, from a safety viewpoint, with that of reinforced concrete, which is largely taking its place for structural framework, might be of some interest to your readers.

The older engineers will readily recall how, in the early years, when wrought iron began to take the place of wood for bridges and other structures, bridge builders and shops sprang up in all parts of the country; how foundries, machine and even blacksmith shops were converted into bridge plants, and how the land was flooded with circulars and advertisements extolling the merits of iron over wood, the result being a strong conviction in the public mind that these claims were true.

Hundreds, if not thousands, of bridges were sold and erected by men ignorant as to design and with very little knowledge of the strength of the materials. These bridge builders were "out for the dollars," and the only competition, if any, was to see who could give the least for the most money. Some of these bridges hardly sustained their own dead weight, and many found early graves in the beds of the streams over which they had been erected. One suspension bridge, over the Genesee River at Rochester, N. Y., went down under no other load except its own weight and that of about six inches of snow falling between midnight and morning, at which time the wreck was discovered; and this occurred even before the bridge had been paid for. Some of these light and insecure bridges lasted for years and sustained traffic—but not with safety, writes Charles F. Lewis, in Engineering Record, Cleveland, Ohio.

In the '70s a bridge of about 90-feet span over the Erie Canal in Orleans County, New York, and owned by the state, after carrying heavy loads for years collapsed one Fourth of July morning from the recoil of a small cannon fired from its roadway and elevated about 30 degrees. A highway bridge of peculiar design located on a main road in northern Ohio went down under a moderate load after being in use 30 years, and an examination made after the wreck disclosed the fact that this bridge should have failed under the first heavy wagon crossing it; but it served its purpose for years, though a "man trap," claiming its victim at the end.

A highway suspension bridge in western Pennsylvania, built in 1873 and still in use, has its cables stressed fully to their elastic limit by the dead weight, plus a light load of snow, which it receives several times each winter; and this on the assumption that the cables are new, while, in fact, they are and have been very badly corroded for years. (Good engineering on the part of its builder?)

Disasters in the early years were frequent, and hundreds of people were killed and injured. A list of these calamities is here unnecessary; suffice it to mention those that occurred in Ashtabula, Ohio; Dixon, Ill., and Albion, N. Y.

Frequent disasters and public clamor led to better designs, especially in railroad work. Purchasers began to employ experts to inspect all materials at the mills as well as the shop and field work, in order to see that the specifications were complied with in every particular. This inspection of material and workmanship soon grew to considerable proportions and has been the leading cause of the present high state of shop efficiency, as it compelled the bridge shops to discard their old "slipshod" methods, go out of business or seek new fields.

After years of thought, consultation and work on the part of the engineering societies and their committees (with the assistance of the engineering journals and the manufacturers themselves), some system was brought out of chaos, and a quality of material was decided upon and approved which to-day is the standard for railroad and highway bridges and for building framework. The working units were fixed at about one-half the elastic limit of the material, thus leaving about 100 per cent inside the crippling stresses as a margin of safety against the uncertainties in material and fabrication. The details of connections designed to develop the full strength of the main members were carefully worked out, simplified and standardized.

The field work has been so improved as to be almost equal to that of the shop. In our modern structural plant, experienced technical men are employed to detail all work, and their drawings are carefully checked by men of still more experience.

This high efficiency in modern shops and field practice, coupled with the fact that the material furnished by the rolling mills can be depended upon with almost absolute certainty, together with the low units insisted upon for new work, makes it possible nearly to double the assumed dead and live loads of our modern skyscraper and still be within the crippling stresses and, therefore, be safe against collapse (undue deflection, of course, aside.)

In this connection it may be stated that on our best steam railroads it is the practice to retain bridges in service while allowing the weight of rolling equipment to increase until the units produced by the live load, added to the dead and impact, have increased the original units by 50 per cent, or until about 75 per cent of the elastic limit is reached, which would not be safe were there any uncertainties as to the materials and workmanship.

There is no doubt that reinforced concrete has come to stay and will largely replace the "all steel" type for many structures—one item in its favor being time, often a very important consideration, for as soon as the engineer or architect has completed his plans, say for a building, the contract may be let and work begun immediately, whereas with the "all steel" type, two weeks, or even months, may be required for the delivery of the grillage beams, the first thing needed.

The combined action of the two materials, steel and concrete, has been largely investigated by engineers, formulae have been worked out and published, full sized members have been tested to destruction and found to develop the full strength of the calculations only when the materials were of the proper quality, correctly proportioned and skillfully put together—a result which depends on a chain of nearly a dozen links, a weakness in any one being a cause for failure. How often are we perfectly sure our chain is perfect in every link? We do know that the human element enters into reinforced concrete to a much greater extent than the "all steel" type of construction, and here is the main point of issue. The field work con-

nected with reinforced concrete construction is a maximum against a minimum in that of "steel," and its quality as far from that attained in the laboratory, in spite of any inspection which may be given it.

Our building codes call for a competent inspector to be on the job during the mixing and placing of all concrete. Can any one man properly inspect even the smallest job of reinforced concrete when the mixing and placing are at some distance apart and going on at the same time? How many inspectors are really competent and reliable; and how many have such a thing as "back-bone," and how many are unsusceptible to slight favors? How often when the inspectors back was turned have we seen the foreman throw one bag of cement into the mixer when two should have been used? Was this batch of lean concrete of importance to the integrity of the structure?

If reinforced concrete were entirely the result of skilled labor, and if everyone connected therewith were striving to attain perfection, even then the human element would largely predominate. In "all steel" the field work is open to inspection for a time before being covered, but with concrete everything is covered with the tip of the barrow.

The present perfection in steel construction is the result of years of education and of the constant efforts of the engineering profession to obtain the largest margin of safety possible. Are the advocates of reinforced concrete and its engineers doing anything along these lines at the present time? The very opposite seems to prevail.

Years ago American engineers abandoned the continuous girder in building construction for good and sufficient reasons. In spite of the fact that no building provides any of the necessary essentials for continuous girder construction, the concrete engineer uses it as a means of reducing cost. Unless there is a uniform settlement of footings and unless the loads are uniformly applied on all floor panels, the continuous action not only fails on floor calculations, but also introduces serious bending in columns. Of course it is always true that reinforced concrete buildings must act as continuous structures, but there is more reason to treat this as a disadvantage than to adopt it as a source of economy. In this connection it seems that the excuse for reinforced concrete is to reduce cost and not to improve construction. With this as a basis, reinforced concrete affords a very fertile field for the contractor who seeks to reduce cost, and it is not necessary to carry the operations of cost reduction to the *n*th power to obtain fatal results. Any change or omission in reinforced concrete construction tending toward reduction of cost but not resulting in immediate failure may become the standard thereafter.

In the case of simple beams uniformly loaded the curve representing bending moments is a parabola with its axes at right angles to the beam, and the rate of increase in the flange stress is a maximum near the supports and zero at the center of the span. In steel construction, such as plate and angle girders, this increment in flange stress is accurately determined and provided for by the spacing of the rivets connecting flange to web. Attempts are made to take care of the vertical end shear in reinforced concrete beams by providing diagonal shear rods, but no attempt is made to care for their increment of flange stress, as in the case of plate girders.

Is there any good reason why designers of reinforced concrete should ignore the initial stress between steel and concrete developed in setting on the ground that it is indeterminate? This seems to be a convenient and prompt method of disposing of such questions.

The factor of safety in reinforced concrete work is made to cover only the materials of construction, and no attempt is made to extend it to include the principal uncertainties. In steel construction, field work is designed with a greater factor of safety than for shop work, notwithstanding the fact that the uncertainty of field rivets is very small as compared with the field work required in reinforced concrete.

Perhaps if we were to provide an adequate factor of safety to cover the field work of reinforced concrete as it now exists we would abolish its use altogether. And would it not be better to do this than continue to say that inasmuch as the field work depends upon uncertainties we will ignore the uncertainties?

One of the principal causes of the uncertainties connected with the reinforced concrete construction is the large percentage of incompetent and irresponsible contractors, the sons of our one-time bridge builders, who are in the business with everything to gain and nothing to lose. The cement and reinforcing material manufacturers are spending millions in literature and advertisements which are fast educating the people into the belief that anything constructed of reinforced concrete possesses the acme of strength and durability, a repetition, but on a vaster scale, of the line pursued to a large extent by the bridge builders of years gone by.

Would it not help to bring reinforced concrete construction into more reliable hands and tend to greater safety and security, if statewide laws were enacted requiring all such construction to be protected by adequate bond against all damages to life and property, not only during the actual construction but for a term of years thereafter, in which the bonding company would assume full charge and responsibility and employ experts to pass upon all plans and inspect all work? After paying several heavy losses it would seem reasonable to presume that their part of the work, at least, would be attended to in a thorough manner. This would not injure the first-class contractor in any way, and the community is entitled to some protection against the wildcat contractor. Of course such bonding would cost money and this resolves into the question, "Which is of more importance, money or lives?"

The writer is not opposed to reinforced concrete but desires to lend his aid toward arousing the engineers of the country to an earnest effort to make this new combination for building purposes "fool-proof," if such be possible. There seems to be abundant room for improvement before the attainment of this much desired end.

CONCRETE SCOW

What may result in a revolution of the method of building scows was the launching of a 500-ton craft by the Furst Concrete Scow Construction Company at the old quarantine grounds Baltimore, Md.

This is the second concrete scow built in Maryland and is the largest, 110 feet long and 28 feet wide, with a depth of 10 feet 6 inches.

While this plan is now in an experimental stage, the first one, now in use by the company, has shown a large saving in repairs over wooden craft.

Joseph J. Hock, vice president of the company, says he is elated over the possibilities of the plan.

Several tug captains who have towed the concrete scow in use think concrete will soon be a big factor in shipping circles.

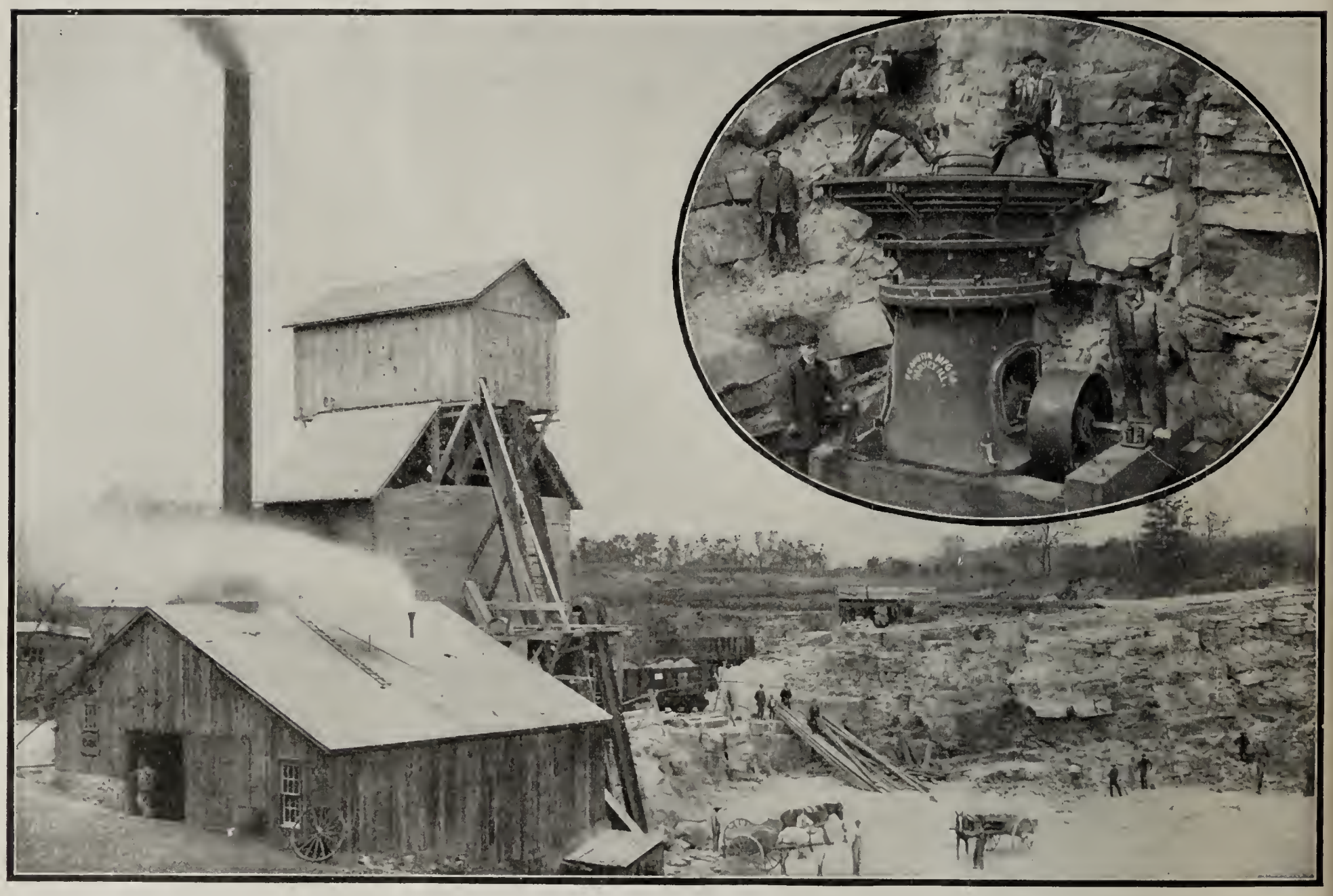
A LARGE QUARRY IN BRITISH COLUMBIA

One of the largest quarries in British Columbia is owned and operated by Messrs. Gilley Bros., Columbia street, New Westminster, and is situated about seventeen miles from New Westminster on the Pitt River. The quarry comprises seventy-five acres secured from the provincial government under a twenty-one year lease.

The pit has been opened out until the face is approximately one hundred feet high. This is broken down in large quantities by drilling holes with Rand No. 43 drills, twenty-five to thirty feet deep on the top on the face and blasting them with high power dynamite. Some charges have moved or broken down 50,000 cubic yards in one blast. The large boulders are then block holed and blasted to reduce them in order that they may be economically handled. After being broken up the material is loaded in cars by a Marion Model No. 35 steam shovel, then hauled up an incline by a double drum Jenckes friction hoist and dumped into a receiving bin over the crushers. The chute from this bin into the large 36x24 inch Farrel jaw crusher is controlled by a finger gate.

The rock, after passing through the jaw crusher, which reduces it to 4-inch size, passes through a No. 6 gyratory crusher, closed down to 2½ inches, and is deposited on a 36-inch belt conveyor, having 90-inch centers. The conveyor conveys the crushed rock to three revolving screens, the first being 54 inches in diameter by 10 feet long and having 1-inch perforations. All material over one inch passes into a second screen by gravity. This screen is 42 inches in diameter by 10 feet long, punched with 2-inch perforations. The 2-inch material passes through the 2-inch holes into bunkers underneath. The larger crushed rock is rejected through the end of the screen into a chute carrying it into the third screen, which is 36 inches in diameter by 10 feet long, and having 3-inch holes at 4-inch centers. The material over three inches passes out of the end of the screen into a bunker so arranged that the rock may be fed into a small crusher and recrushed, or loaded on to a scow and sold for ribble rock, or overs, as they are sometimes called.

The bunkers are so arranged that the product can be loaded on scows in a short time by double chutes from each bunker or pocket. In fact a scow with a capacity of 175 cubic yards can be loaded in two hours.



PLANT OF BELLEVUE STONE CO., AT BELLEVUE, OHIO, EQUIPPED WITH A NO. 7½ AUSTIN GYRATORY CRUSHER.

The power for this plant is furnished by three Pelton water wheels, under an effective head of 550 feet. A much greater head can be secured if necessary, for at the back of the quarry is a range of hills, 2,900 feet high, on top of which there are three lakes averaging forty acres each and about twenty to thirty feet deep. These lakes are connected to each other by small streams, which have been cleaned out to allow a clear flow of water, and individually dammed, allow regulation on the quantity of water required at the quarry. The power now consumed is about 400 h. p. for running the crushers, conveyor screens and air compressor. An early extension of the power capacity is planned and by next summer it is probable that 800 h. p. will be utilized.

The plant is considered most efficient and economical. It was designed by Mr. Geo. K. Williams, consulting engineer, and Mr. P. Munroe, superintendent of Gilley Bros.

The air compressor and drillers were supplied by the Canadian Rand Company; the gyratory crusher by the Allis-Chalmers-Bullock Company; the large jaw crusher, conveyor-screens, hoisting engine, pulley and shafting by the Jenckes Machine Company.

Messrs. Gilley Bros. own three steam tugs and a fleet of eighteen scows by which the finished product is conveyed to New Westminster, the municipality of Ladner, the municipalities of South Vancouver, Coquitlam, Point Grey, Delta, Burnaby and Richmond. The capacity of the plant averages 2,700 cubic yards a week of six days.

DEFECTS IN CONCRETE SANDS.

Renewed interest in the subject of sand requirements has been aroused by an article recently appearing in "Engineering News," from the pen of John R. Freeman, consulting engineer, of Providence, R. I.

It is a fact beyond all doubt or question that here and there are banks of sand and gravel which, upon ordinary inspection, appear ideally perfect for making mortar and concrete, but which are nevertheless dangerous in the extreme, and all because of some ultra-microscopic content probably similar to tannic acid (in a colloidal film around the sand grain), which works in some mysterious way to prevent the union between the cement and the sand grains.

The author cites an occasion where he found, at the site of a proposed dam, what promised to be a most economical resource in the shape of excellent sand and gravel; but, upon being tested, some of the samples of 1:3 mix—six days in water—hardly maintained their integrity while being placed in the clamps and before any load was applied. The cement was of a brand that had given excellent results with other aggregates. The tests were made by Sanford E. Thompson. The subject was called to the attention of several experts. who advanced various theories in explanation of the defect, among them E. E. Free, an investigator in the borderland between chemistry and physics, for some years past connected with the Department of Agriculture at Washington, D. C., and now engaged upon physical and chemical investigations for the Bureau of Soils, with particular reference to the means by which the plant is able to take into solution the mineral ingredients, silica, etc., required to strengthen its constitution. Mr. Free had run across analogous phenomena in studying the relative fertility of different soils. He said that in popular terms the situation could perhaps best be explained by considering that an extremely thin film of a complex form of tannic acid surrounded each grain of the troublesome sand, and prevented its attachment to the cement; that these complex organic acids had a strong tendency thus to spread themselves thinly and strongly adherent over the outside of the siliceous material; and that the reason why one particular brand of cement was able to break through this filmy barrier so as to get a firm grip upon the sand grain, was because of its containing a small quantity of some form of alkali that united with this acid film or somehow changed its colloidal state.

Discussing the matter editorially, the "News" reviews briefly the history of investigation along this line, and treats the subjeect in part as follows:

A tendency to stiffen the sand test was shown in the following clause from the Report of the Joint Committee on Concrete and Reinforced Concrete:

"Mortars composed of one part of Portland cement and three parts fine aggregate by weight, when made into briquettes, should show a tensile strength of at least 70 per cent of the strength of 1.3 mortar of the same consistency which is made with the same cement and standard Ottawa sand."

This clause, if inserted in concrete specifications, would exclude many defective sands, even though it does not help in the question of what makes them defective. Unfortunately, it is rarely called into play. There are a number of reasons for this, principal among which is the reluctance of engineers to force the contractor to make what he considers an unusual and unnecessary test. There are also the difficulties of sampling and storage to overcome; but in the main the trouble lies in the inertia of established custom. Attempts are being made by several societies to bring this matter of definite sand specifications to a head, and we may expect a marked advance in the near future.

We are quite aware that these defective sands are the exception rather than the rule, and that there will be a number of engineers and contractors who will think the whole investigation a highly interesting laboratory amusement of no value whatsoever to practical construction. The fact remains that there are sands whose availability for concrete aggregate cannot be predicted under any of the ordinary methods now in vogue, and that every so often one of these sands gets into a structure to its detriment. The reasonable thing to do, then, is to provide some practicable test for such sands; and to devise such a test intelligently requires a knowledge of the reasons for the defects in the sand.

BACHMAN SAND AND STONE COMPANY.

The Bachman Sand and Stone Company, Allentown, Pa., was recently incorporated with $200,000 capital stock by Henry S. Reed of New York and his associates and Milton H. Bachman and Capt. James L. Schaadt of Allentown and their associates. The company have purchased the sand and gravel business and plant of M. H. Bachman & Co., they being the leading producers of sand and gravel in the Lehigh Valley; the company also have secured under royalty lease for thirty years 23 acres in the city of Allentown containing millions of tons of sand and gravel. The sand and gravel plant to-day has an earning power of $17,500 a year, but the company will increase its capacity fourfold.

The company have purchased two of the Fisher hydraulic reconstructed stone or concrete machines, a large one for manufacturing dimension stone and trim and a small one for the manufacture of two piece wall stone. These machines will be installed in a factory 250x50 feet in which all of the best appliances known to the industry will be brought into play. Curing will be by the steam process and instead of industrial cars an overhead trolley system will be used. The building operations of Allentown last year amounted to $2,500,000, and by using the electric car line and the automobile trucks of the company a prosperous community of 250,000 people are reached economically.

Mr. Reed brought into existence the Standard Concrete Company of Poughkeepsie, N. Y., and the Peekskill Stone Company of Peekskill, N. Y. The Jaeger machine is used at Poughkeepsie and the Fisher machines at Peekskill. It is said that the Peekskill Stone Company's plant is a model of its kind. It is a creation, not patterned after any other plant, and is the result largely of Mr. Reed's and Mr. Fisher's creative ability. The plant here will contain certain improvements which will make it clearly, it is confidently believed, superior in its working capacity of any other plant in the country and the field here for business is exceedingly good.

HIGHWAY ARCH BRIDGES

The Larimer avenue bridge, Pittsburgh, Pa., completed in 1912, is rightfully placed at the head of the list of American bridges. There are two other bridges (both highway bridges) in the world of longer span, but they are of much smaller proportions otherwise; namely, in width and height. The longer span bridges are: one at Rome, Italy, with a span of 328 feet; and the Auckland, New Zealand bridge of 320 feet span. The Larimer avenue bridge with a clear span of 300 feet, 4⅞ inches, a width of 50 feet, and a height of 115 feet, can therefore be justly called the largest concrete arch in the world in point of size and third largest in length of span. The bridge is 670 feet long with a roadway 30 feet wide in the center, flanked by cantilevered concrete sidewalks 10 feet wide.

The arch ribs are five-centered, an approximate parabola, with a rise of 67 feet and intradosal radii of 186 feet, 1 inch, 241 feet 8½ inch, and 216 feet, 10½ inches. These ribs are 8 feet wide and 6 feet 6 inches deep at the crown and 11 feet deep at the haunches and are spaced 30 feet center to center, cross braced at points of spandrel arch columns. The reinforcement of each rib consists of eight 6x4x¾ inch angles latticed together with flat bars to form a deep lattice-girder, with a total section of 55½ square inches. Although the ribs as designed are subject to compressive stress only, the steel was added to provide an added factor of safety and make the entire structure more rigid.

The roadway girders supporting the reinforced concrete stringers and floor slab, are carried by reinforced concrete columns 19½ feet centers, resting on the arch ribs, connected at the top by the circular spandrel arches. The sidewalk is supported by concrete brackets at the spandrel column centers. The approach arches have a clear span of 25 feet and are carried on columns in a manner similar to that of spandrel arches. There are four approach arches at the west end and three at the east end of bridge.

The main piers are of cellular construction with reinforced concrete face walls extending up to sidewalk. The abutments are reinforced concrete U-abutments filled with earth. Ornamental steel hand rails are supported by paneled concrete posts at panel points of spandrels, on the bridge proper, the rail over the abutments being a solid paneled concrete wall.

The surface finish of this bridge is very fine as shown by the illustration. The main surfaces were bush hammered and other parts were rubbed with carborundum bricks.

This structure is a very graceful and attractive one in every way. The ornamental copings, hand rails and the excellent proportioning and finish of the bridge as a whole, as well as the various parts, gives it an artistic appearance not possessed by many arches. As an example of economic and esthetic design it stands without peer.

Compared with the first concrete arch bridge built in America (in 1893), the Pine Road bridge at Philadelphia, with two 25-foot spans, one obtains some idea of the progress made in the design of concrete arches in a period of 20 years.

NEW CONCRETE BRIDGE, PITTSBURG, PA.
John F. Casey Co., Pittsburg Contractors.

HOW TO ATTACH PLASTER TO CONCRETE

The Aberthaw Construction Co., Boston, Mass., recommend the following method of attaching plaster to concrete. "Make the concrete as porous as possible by omitting sand from the mix and by not spading the concrete next to the forms. Where plaster is required underneath a floor or roof if the forms are sprinkled with ½-inch stone before the concrete is placed, a rough surface will be obtained to which plaster will key nicely.

To attach Portland cement plaster to smooth concrete, hack the surface with a point, brush the surface thoroughly to get the dust out, wash it, and in every case make sure that the under concrete is thoroughly wet before the plaster is applied. Otherwise the water will be soaked out of the plaster and the plaster will not adhere. Wash the surface with grout just ahead of the plaster and make sure that the plaster is applied before the grout has time to set.

It is the experience of the Aberthaw Construction Co. that lime plaster is very unsatisfactory for placing on concrete surfaces. The only way they have been sure of a satisfactory result is to use plaster which is principally composed of plaster of Paris.

CORRECTION

The article which appeared on page 123 of our April, 1913, issue entitled "Pulverized Coal as a Fuel," by A. W. Raymond, was copied verbatim from the February issue of Metallurgical and Chemical Engineering. Through error we failed to give this magazine credit.

1914 CEMENT SHOW

The Seventh Chicago Cement Show will be held in the Coliseum, February 12-21, 1914. The Coliseum has again been leased by the Cement Products Exhibition Company, 72 West Adams street, Chicago, for the next national Cement Show for a period of nine days. The Show will open on the evening of February 12, and close on Saturday evening February 21. This is a longer show than has been held heretofore, but as there will be only one Show next season it is felt that larger benefits will be derived by extending the show two days longer than hitherto. While the exhibition will be conducted along the same general lines as in the past, a number of changes have been adopted. In addition to holding the show open for a longer period, the space units have been increased in size and the rates for space decreased. Some innovations in the way of booth equipment are also in prospect.

With the announcement of the Seventh Chicago Cement Show comes a bulletin from the office of the National Association of Cement Users, Harrison Building, Philadelphia, Pa., giving the place and time for the Tenth Annual Convention as Chicago, February 16-20, 1914. The holding of the cement show and the convention in Chicago at the same time, means a tremendous gathering of concrete interests February next. President Humphrey is already at work preparing the program of the sessions of the Association. The officers of the National Association of Cement Users are: President, Richard L. Humphrey, Vice Presidents, Arthur H. Talbot and Leonard C. Wason, Treasurer Henry H. Quimby, Secretary Edward E. Krauss, Directors: B. F. Affleck, Wm. P. Anderson, Edward D. Boyer, W. L. Church, Chas. Derleth, Jr., and E. L. Ransome.

SETTING PROPERTIES OF PORTLAND CEMENT

G. Hentschel, in Tonindustrie-Zeitung states that in his opinion the change of cement from slow to quick setting is due to the presence of alkali carbonates, which as positive catalytic agents have an accelerating influence on the setting process. The addition of only 0.01% of sodium carbonate in one case reduced the time of setting from about 6½ hours to 20 minutes. On the other hand, the addition of varying amounts of calcium sulphate retards the time of setting, and the cements remain slow setting. The power of catalytic agents should be determined by comparative experiments; sodium and potassium carbonates exert an extraordinarily strong positive effect, while calcium sulphate possesses a relatively smaller negative catalytic effect. The positive effect also is much more marked with finely ground cements. By the burning, any alkali present in the raw materials is converted into an alkali silicate which exerts no effect on the setting, but by exposure to the air these silicates after the clinker has been ground, are slowly decomposed into silicic acid and carbonate, especially under the influence of heat. Experiments on a particular cement showed that the time of setting was accelerated by heat, with free access of air, but when carbon dioxide was excluded, the time of setting was unchanged after heating the cement on a water-bath for an hour. The pronounced effect of carbon dioxide and heat explains why rotary kiln cement changes much more easily than cement burnt in other kinds of kilns, and often leaves the mill in a quick-setting condition. Rotary kiln clinker tends to be hard, and is consequently heated to a considerable extent by grinding—a temperature of 87° C. has been noted—and on cold days there is less danger of producing a quick setting cement and it explains why rotary kiln cement also generally contains a rather larger amount of alkali than cupola-furnace cement, probably derived from the ash of the fuel, of which a larger amount is required in rotary kilns. The change in the time of setting produced by the addition of calcium sulphate is independent of the presence or absence of water of crystallization in the calcium sulphate. In order to test the likelihood of change in the time of setting, a brisk stream of carbon dioxide is passed for 10 min. over 200 grms. of cement contained in an Erlenmeyer flask, provided with a ground stopper. The cement and gas are shaken well, and the operation repeated three times. Finally the closed flask is heated for 1 hour on a water-bath, care being taken that no condensed water can enter the neck of the flask. The cement is spread in a thin layer to acquire the room temperature and the setting test applied in the usual way. If the time of setting is less than an hour, the cement is open to suspicion. In order to avoid this fault in cement the content of calcium sulphate should be raised to the permissible limit, and also the content of lime, so that the clinker will crush easily and, not being steel-hard, will not become so hot during grinding; for the same reason the use of still moist clinker must be avoided, and in some cases the grinding must be coarse only.

SAMUEL. L. MOYER

Samuel Lyon Moyer, first vice president of the Lunkenheimer Company, Cincinnati, Ohio, died at his home, 126 Garfield place, last week. Early Friday morning Mr. Moyer passed into a state of apparent coma, which continued until shortly after dawn Saturday.

Friday night Dr. Harry Hines, who had been in constant attendance, abandoned hope, and informed friends and relatives that death was a matter of a very few hours.

Mr. Moyer was born in Cincinnati August 17, 1874. He was the son of the late Joseph Moyer, for years connected with the local postoffice. Sam, as he was known to his host of friends, was a pupil of the First Intermediate school, and later attended the Woodward High school, from which he graduated. He had been connected with the Lunkenheimer Company almost since that time, working his way up to the management by his industry and ability to make friends.

Mr. Moyer was a Republican in politics, and for two terms, ending when Mayor Hunt assumed office, he was councilman at large. He made an excellent record in the city law-making body, his vote being always cast on the side of the poorer people of the city and for civic progress and betterment. When it came to measures for the public welfare he was never a partisan. Much of the good that was written in the municipal law had its initiative or strong support from him. It is no secret that had Mr. Moyer lived and regained his health he would very probably have been the next candidate of his party for the mayoralty. His popularity was so apparent and his standing so high in the business world that he commanded the attention of his party as their most available leader.

THE PRODUCTION OF SAND-LIME BRICK IN 1912

The sand-lime brick industry has been established in the United States a little over 10 years, and in Europe, especially in Germany, where it is a large and flourishing industry, for a much longer period. In this country it has passed through many vicissitudes. At first it grew rapidly, rising from 1 plant in 1901 to 16 in 1903 and to 57 in 1904, and in 1907, 94 plants were in active operation, reporting products valued at $1,225,769. This growth was not, however a healthy one. Many plants were erected where market conditions were not propitious and others where suitable materials were not available; others, although conditions and materials were satisfactory, failed for want of technical skill or because of poor management. Consequently many plants that were erected in the beginning of the industry are not now operating, and some of them never even began operations. Notwithstanding this serious handicap and the fact that the value of the product decreased almost constantly from 1907 to 1911, in 1912 the number of plants in operation increased and the value of the product showed a large gain. During 1912 some of the abandoned plants were taken over by skilled men, were remodeled in accordance with the latest developments, and are now being operated successfully. The prospects for 1913 are bright, the future of the industry seems established, and a steady growth may be expected. There appears to be a successful field for the sand-lime brick industry, especially where other building materials are scarce and sand is plentiful and lime accessible. The product, as shown by experience at home and abroad, may be made durable and attractive, and tests made on it show that it meets all requirements as a building material.

The manufacture of sand-lime brick showed considerable progress in 1912 over 1911. The value of the product reported in 1912 was $1,170,884, compared with $897,664 in 1911, an increase of $273,220, or 30.44 per cent. In 1911 production decreased $271,489, or 23.22 per cent, from 1910, so that the value in 1912 was slightly greater than that of 1910 and only 4.48 per cent less than that of 1907, the banner year in the industry.—[Dept. of the interior—U. S. Geological Survey.]

A FINE GRAVEL PLANT

The Ohio River Sand Company of Louisville, Ky., is one of the oldest as well as one of the largest sand reclaiming concerns of the country. About ten years ago they installed a mammoth derrick crane for the purpose of unloading sand from the decks of barges floating at the dock below. It was one of the first electrically driven hoists to work out successfully. Their unloading and storage system is the best and most economical ever built. This is largely due to the natural "lay of the land," so to speak, for the clam-shell which gets the sand at the deck of the barge delivers it in a hopper that transfers by a gravity system to a trestle about 300 feet long which provides bins for loading wagon boxes and cars beneath the trestle, which is in fact a traveler for the transfer cars. This part of the plant was worked out by James T. Duffy, now deceased, who was president of the company at the time. The sand supply comes from the bed of the river about twelve miles above the city of Louisville and is loaded upon barges and towed down stream to the derrick dock.

The washing, screening and separating problems have recently been perfected by Thomas J. Duffy and John M. Settle, the present officers of the company, in a campaign of more than a year which has procured for them one of the most perfect and complete sand producing plants in existence. They have a screen 60 inches in diameter, having 17½ feet of screening surface; the head end having ⅜-inch slot perforations and the lower end 1¾ inches round. This portion of the screen, as well as the head and tail rings, trunnions, blank discharge portion of the screen and induction chute, are all of manganese steel and the screen is driven from below the deck with a manganese steel chain. The screen is supplied with a 12-foot sand jacket of punched steel plate with 3-16 inch perforations.

This screen is designed to separate approximately 1,000 yards of sand and gravel in the two sizes per day. The over size gravel which passes through the screen is let through a pipe to a No. 4 Champion crusher installed on the deck, which is intended to reduce everything to sizes under 1¾ inches. Separate engines have been installed to run the crusher and the screen independently.

The material is won from the bed of the river by a 12-inch Morris centrifugal pump. The pump and pipe, elbows and nipples being fitted throughout with "Tisco" manganese steel to take care of the wear; the idea being to equip the digger to such a degree of resistance against wear and ordinary renewals that they may operate continuously through the digging season without stoppages for repairs. The whole installation is built upon a river steamboat of 200 tons rating, the base frame being carried with 12-inch I-beams.

This company operates two diggers, the other being equipped with a recently installed 10-inch Morris centrifugal pump of high efficiency.

This washing and screening improvement on the steamboat makes it possible to do all that part of the work with one handling so that from the sand island to the dock it is a straight proposition of delivery. H. A. Johann and Martin O'Shaughnessy of the Taylor-Wharton Iron and Steel Company, helped to work out some of the good points with their expert knowledge of manganese steel castings and their adaptation to such uses.

The Marion Sand & Gravel Company, Marion, Ind., employ a drag-line dredge made by the Lambert Hoisting Engine Company with a capacity of one yard bucket for taking sand and gravel out of the Mississinewa river and lately they have installed a gravity screening device. The entire plant is very efficient; ½ the aggregates is sand which passes through a 5x5 screen, or mesh and ⅛ through a 3x3 screen; ⅛ through a ⅝ screen; ⅛ through a 1¼ screen; ⅛ through a 3 inch screen.

The Louisiana Sand, Gravel & Construction Company, West Monroe, La., announce that they are enjoying a very good season and are taking care of all orders with dispatch. They load their sand with a Marion Model 60 steam shovel manufactured by the Marion Steam Shovel Company, Marion, O., which they own as well as standard gauge locomotive and four miles of standard gauge 60 lb. track. They do not operate any crushers as their stone is of the correct size, all passing an 1½-inch perforation.

Damage amounting to $15,000 was caused by the premature explosion of dynamite at the operations of the Boswell Sand Company, at Boswell, Pa.

GRAND TRUNK PACIFIC ELEVATOR

The Grand Trunk Pacific, the latest of the three Canadian transcontinentals, has planned to construct what will be the largest grain handling terminal in the world. Its terminal elevator system at Fort William is designed in four units of 10,000,000 bushels capacity each, and the first section having a capacity of three and one-half million bushels has just been completed.

The elevator is of reinforced concrete and was designed and built by the Canadian Stewart Company, Limited.

The method of handling and placing the concrete did not differ much from the general practice in such work excepting in the placing of the concrete for the circular tanks, for which forms of an original design were employed.

The forms consist of an inner and outer section four and a half feet high held apart by yokes, a sort of a steel clothespin made up of plates and channels and supported by lifting jacks.

The essential element of the invention is a hollow jack screw through which is inserted a vertical rod and upon which the jacks are made to climb and thereby raise the forms. In operating the jacks, a workman inserts a bar in a socket, causing a screw to turn. By turning to the left the jack itself climbs the rod while the forms remain stationary, being supported by the adjacent jacks.

Upon completion of the tanks, the erection of the steel cupola framing was commenced. Fifteen hundred tons of steel were used in the construction. Sheet metal frames glazed with ribbed glass and steel clad doors completed the construction of the buildings which are fireproof to the last degree.

SAND DEALERS IN KANSAS HAVE NEW LAW

The new state law requiring sand dealers to pay to the state ten per cent of all their gross receipts for sand taken from the streams of Kansas will realize a revenue in Lawrence of between $300 and $400 per year as nearly as can be estimated from figures given by local sand dealers.

But the sand business, never a very flourishing or profitable industry, is threatened by this new legislation. Ten per cent of the gross receipts is figured as a very high tax and it may be that in order to keep up the margin of profit dealers will raise the prices on sand. At the present rate of sand and paying ten per cent of this to the state the profit to the dealer would be very low.

There are two dippers in Lawrence taking sand from the river. Owners of these estimate that if they sell $100 worth of sand a month it is a big month. There are a number of men who are hauling from the sand bars in the river and it is estimated that the total sale of sand during a good month is about $500. During the winter months where there is little building there is practically no demand for sand and the industry is discontinued.

Another question has arisen in connection with the new sand bill that is of local interest. There are men in North Lawrence who are paying taxes on sand bars. At one time this land was high and dry above the river but floods have washed the land away and left in place a sand bar. Now these parties are still paying taxes on the land and are hauling sand from it. It is a question whether or not the state can collect a revenue on this sand.

At a meeting of the executive council in Topeka recently that body adopted resolutions, containing the rules under which contracts for taking sand will be let.

Any person desiring to take sand or other products from the bed or channel of any navigable river for the purposes of sale shall first make application in writing to the executive council. If the executive council shall act favorably upon the application such person shall then execute a contract with the executive council.—[Lawrence (Kan.) Journal.]

H. D. Conkey Sand & Gravel Company, Mendota, Ill., announce "the purchase of the F. D. Hawkins gravel property at Moronts, Illinois. Extensive alterations and repairs which will largely increase the capacity of the plant are under way and in contemplation, and on or about May 10th, we will be ready to make shipments of washed sand and gravel of the highest grades.

"It will be our endeavor in operating this property to give prompt and satisfactory service, and we trust that by turning out a high-class screened and washed product, combined with our personal efforts to give customers the right kind of treatment, we will merit and receive your patronage.

"Shipments can be made on through rates via C. I. & S. C. M. & St. P., Illinois Central and Wabash railroads, and all inquiries and correspondence should be addressed to our Mendota office."

A. O. Caruthers, formerly of Hickman, Ky., will open a concrete factory there about June 15th. Machinery for this plant has arrived and will be put in place in a few days. The buildings for housing the concern have been finished. This will make two concrete factories for Hickman, as the Hickman Concrete Company have been located here for some time.

NIAGARA RIVER SAND

An effort to settle the long standing warfare between owners of river frontage along the valuable sand and gravel beds of the Niagara and operators of sandsuckers through the enactment of a bill that will permit the taking of sand and gravel from the river under State license is to be made, says the Buffalo Courier. Representatives of the contending interests had a meeting with the Erie Democratic members of the Legislature at headquarters yesterday afternoon and the outcome was a promise from the legislators that the bill will be introduced and given a fair chance of passage on its merits. This satisfied the sandsucker operators. The river front owners may buck the bill at Albany.

The bed of the river in the American channel, between Strawberry Island and the mainland about opposite Riverside Park, is composed mostly of sand and gravel which by the time it is dug up and delivered at a city dock is worth in the neighborhood of 75 cents a cubic yard. A few years ago the sandsucker was developed and several Buffalo men and corporations bought scows, equipped them with the necessary machinery and went to work transporting the river bottom to local sandyards. Then the owners of the lands along this stretch of river, the Empire Limestone Company and the Border Island Land Company, put in a claim of ownership of the beds that lay off their properties. They took the case before the courts, claimed that the sandsuckers not only sucked up the bed of the river but were eating away their uplands and secured injunctions. Then they charged the sandsucker men a royalty for every yard of sand taken from the beds. Notice was served a while ago that this royalty would be ten cents a cubic yard.

The sandsucker men got together and had prepared the bill which will enable them to operate in the river without paying royalties: Henry W. Killeen argued their case before the legislators yesterday. Charles Diebold, Jr., and Fred D. Corey appeared to see that the rights of the abutting landowners were not overlooked.

Arguing for their respective sides occupied the lawyers most of an hour. Quite a number of the sandsucker owners were on hand to tell how burdensome the royalty is to them. Councilman Allan I. Holloway, who is interested in one of the companies owning the uplands, was around last week to represent his concern. At the close of the session, when it was announced that the bill will go in, Mr. Killeen said its enactment would mean preventing an increase in sand prices to builders.

CONCRETE ROADS NEAR BOISE

Road work performed by Ada county, Idaho, during 1912, was under direction of Arthur E. Fox, consulting engineer, Boise. One section of the work consisted of three miles of 2-course concrete road extending from the city limits of Boise northwesterly along the line of the Boise Inter-urban railway. After preparing a sub-grade in the prescribed manner the first course was laid, consisting of a 5-inch layer of concrete, mixed in the ratio of 1 part cement, 3½ parts sand and 7 parts gravel. The second course laid immediately after the first, consisted of a 1½-inch layer of concrete, made up of 1 part cement, 1½ parts sand and 3 parts of crushed rock, the rock having a maximum of ¾-inch diameter. The second course, constituting the wearing surface, was carefully floated to make it uniformly smooth. Finally, before the surface became dry it was covered by a half-inch layer of sand and kept moist for a few days. This road is 20 and 24-feet in width. In addition to this, an 1800-foot concrete flume was built to Boise river to care for a troublesome deposit of sand which in times of freshets would bank up against the road. The flume cuts the road at right angles, passing under it through a concrete culvert. The side drainage consists of a 4-foot canal on one side; and a small channel on the opposite side, which at quarter-mile intervals drains through a culvert to the main canal.

The other section of work was an extension of the Meridian road. It starts at the city limits of Boise and runs toward Meridian and Nampa. On this line of one and one-half miles of 3-inch water-bound macadam and 4-inch concrete road was built in 1911, and during 1912 about one and one-fourth miles of two-course concrete road was constructed similar to that described above. The macadam-concrete road has a width of 16 feet, with a shoulder of crushed rock on each side. Part of the 1912 road is 24-feet wide, with curb and iron rail on each side, the other part being 20-feet wide.

WADE'S ACCESSIBLE SEWER SYSTEM

James J. Wade for years has been one of the most successful plumbers and done the plumbing and sewerage in many of the great skyscrapers and buildings of modern construction in Chicago. Years ago he did a large amount of repairing and refitting of houses where plumbing and sewerage were defective.

When called upon to repair defective or clogged up sewer pipe he always had trouble. It must be understood that the sewer pipe runs from the main sewer underneath the floor of the house cellar, and to find it and its lateral branches it became necessary to tear up the wood or concrete floor, which took a great deal of time and was very expensive. After the defective pipes were repaired and put in good order the floor of the cellar had to be relaid.

These troublesome conditions gave him the idea of devising accessible clean-out sanitary pipe fittings, with large manholes, connected with the main house drains and lateral branches. They are provided with extra heavy cast iron manhole clean-outs, extending from the sewer pipes in the ground to the level of concrete or wood floors of cellar. Each of these manholes has an extra heavy metal cover, fastened to the manhole, with electroplated lubricated steel bolts and gasket, easily removed any time by any unskilled person for the purpose of rodding, cleaning and flushing the main house drains or lateral branches without removing the floor of the cellar.

He secured patents covering the fittings and commenced manufacturing and installing what is now known far and wide throughout the country as the Wade Accessible Sewer System. Architects were quick to see its practicability, its great advantages and recommended and included it in their specifications.

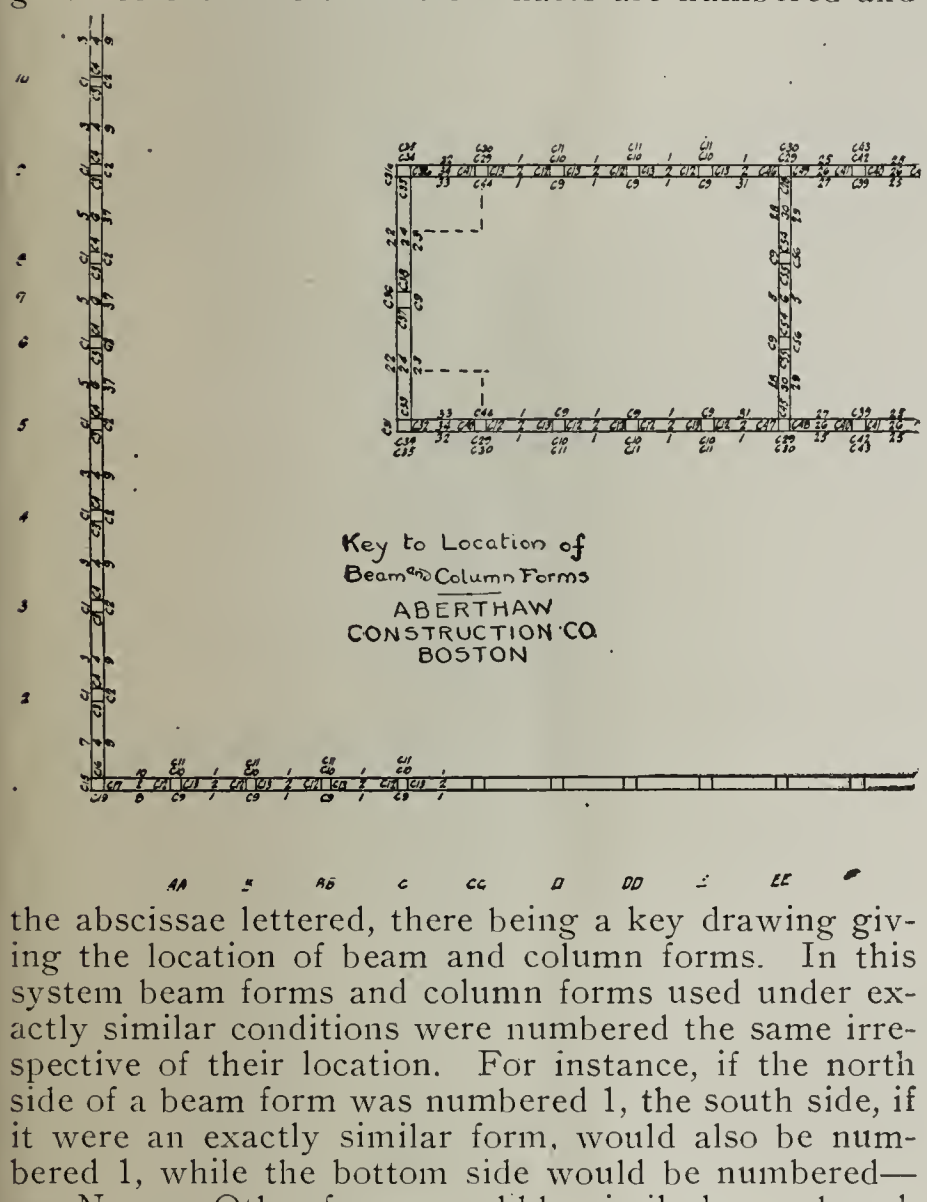
Its recognition has been marked. J. J. Wade, the founder of the Wade Iron Sanitary Manufacturing Company, Chicago, said that it is the only accessible sewer system in existence in the world, and that shipments are made from Maine to California and from Canada to Mexico. The Wade system complies with municipal ordinances governing house drainage work, corrects house drains, prevents disease and preserves life and health.

AN ECONOMICAL METHOD OF NUMBERING FORMS

The introduction of methods to reduce the cost of form work is an ever-present aim of the Aberthaw Construction Company, Boston, who by careful study have reduced the cost of their forms about 20 per cent in the last few years. One of the most recent schemes which has effected an economy is the simplifying and systematizing of the numbering of the various forms.

In previous work the Aberthaw Company lettered the forms for beams and columns in reference to the compass, that is, if a form was to be used on the east side of the building it might be marked "BSE18," which would mean that it was for the beam side of beam No. 18 on the east side of the building. The bottom form of this same beam would have the symbol "BBE18." While this lettering was a decided improvement over any other method used, there were disadvantages and it was to eliminate the same that the present system was devised.

According to the present method each column is given co-ordinance. The ordinates are numbered and



the abscissae lettered, there being a key drawing giving the location of beam and column forms. In this system beam forms and column forms used under exactly similar conditions were numbered the same irrespective of their location. For instance, if the north side of a beam form was numbered 1, the south side, if it were an exactly similar form, would also be numbered 1, while the bottom side would be numbered—say No. w. Other forms would be similarly numbered, although they might be located in another part of the building. In the case of columns, the letter "C" was prefixed to the number. If the forms for a column were marked C10, C11, C12 and C9, forms for a similar column would be marked in the same manner, though they might be located at another point.

It will be seen by this method many letters are eliminated from the symbol. In addition, simplifying the numbering has avoided excessive lettering in the drafting room and saves time which might be spent on stenciling at the job. Furthermore, it quickens the time spent for locating a specific form for similar forms are all piled together.

In order to give some idea of just how hard it is to cut down the different kinds of forms to a minimum it should be noted that on the simple job in question there were more than 100 forms while every effort had been made to reduce this figure.

PERMANENT ROADS.

That the interest in permanent roads is increasing is evident by reports which come from all parts of the country. One of the most recent is from Berrien county, Michigan, where the board of commissioners voted on and authorized the issuance of $500,000 worth of bonds, the money to be used in building good roads through the country.

Two years ago the county adopted the country road system, but found this method too slow for its purpose and consequently has just accepted the bond issue plan as a more expeditious means of accomplishing the desired end. The state aid fund will amount to about $100,000, which will bring the total to be used on good roads to $600,000. This will probably be extended over a period of five years, and provision for retiring the bonds will be made from the regular tax levy extending over a term of twenty years. The members of the county board are studying the various forms of permanent road construction and they are reported to be favorable to the use of concrete. Splendid results in building concrete roads have been obtained in various localities, notably in Wayne county (Detroit), Michigan. The concrete country roads around Detroit have been visited by scores of delegations of interested road builders from all over the country. Concrete roads are already playing an important part as a consumer of cement. In Wayne county, Michigan, 100,000 barrels of Universal Portland cement were used in 1912, and an additional 100,000 barrels of the same brand will be used in 1913.

SPECIFICATIONS AND METHODS OF APPLYING STUCCO

First Coat

1 Bag of Hydrated Lime.
2 Bags of Cement.
Mixed dry until the color of mass is uniform.

Second Coat

1 Bag Hydrated Lime 40 lbs.
4 Bags Cement.

In Top Coat

No Lime.

The best mortar is composed of three parts sand to one part of the cement and lime mixture. The proportions of one to three to be used in each coat, which of course, means the top will be a one to three Portland Cement Mortar. Use just enough water to enable it to work easily.

The first coat should be well scratched and second coat put on when the first coat is set enough to carry it.

The second coat should be scratched and the third coat applied before the coat below is thoroughly set.

Each coat should be wet before the next coat is applied to prevent the rubbing off.

Moisture Required for Setting

The best way to insure a good surface is to hang burlap or canvas a few inches away from the plaster and keep this cloth wet for a week.

Lath to Be Used

Metal lath alone should be used as it is free from temperature changes and the plaster is thoroughly reinforced, so the stucco becomes a reinforced concrete slab over the whole surface. Wooden laths should be green, or well soaked with water.

By using the above mixture, after securing practical plasterers to apply this stucco, there is no question why you should not get a first class job.

LEHIGH PORTLAND CEMENT CO.

A FIRE-PROOF DWELLING

The illustration herewith is the home of Mr. James Goggin, plastering contractor, of Chicago, Illinois, which shows the adaptability of fireproof construction to dwelling houses. There are wonderful possibilities in this line and a description of the method of construction will be interesting to everyone connected with the building industry.

The main vertical studding consists of 4-inch I-beams. I-beams are also used for sub-sills and lintels of large openings. One and one-half inch angles are fastened horizontally across the I-beams about every four or five feet. Three-quarter inch channels are placed vertically twelve inches on centers and fastened to the angles. Twenty-four gauge painted Kno-Burn Lath, manufactured by Northwestern Expanded Metal Company, Chicago, is wired to the three-quarter inch channels with No. 18 gauge tie wire.

The exterior was plastered one coat and then back plastered on the inside of the wall so that all of the construction except the I-beams is encased in Portland cement plaster. The completed exterior wall is two inches thick.

The inside of the walls was lathed with 24-gauge painted Kno-Burn Lath and plastered in the usual manner, on one side only to a thickness of one and one-quarter inches.

While the floors in Mr. Goggins' house were of wooden construction, reinforced concrete floors could be used, thus making an absolutely fireproof building. The floors are carried by four-inch by three-inch angles.

CEMENT PIPE FOR SEWER PURPOSES

The following letter was received recently from Mr. N. L. Morris, president of the Atlas Concrete Pipe Machinery Company, Salt Lake City, Utah, viz.: "Your April issue contained on page 122 a letter dated at Santiago, Union, December 10th, which makes some seemingly serious objections to the use of glazed cement pipe for sewer purposes. City Engineer E. M. Copps and H. Clay Kellogg are the two engineers who agree upon these objections.

"The second paragraph in that letter contains statements which we are satisfied cannot be verified and are wide of the mark, if we are to take the opinions of from fifty to one hundred city engineers throughout the country who have used concrete for sewers for from five to fifty years.

"What interests us most particularly, however, as an answer to this letter is one that we have just received from Mr. F. M. Lockwood, assistant superintendent of sewers, San Diego, California, a copy of which we herewith attach, which we think ought to be published in your journal out of fairness to the concrete sewer pipe business."

DEPARTMENT OF FIRE AND SEWERS
City of San Diego.
San Diego, California, April 13, 1913.

Utah Glazed Cement Pipe Co., Salt Lake City, Utah.

Gentlemen: Your letter of the 8th inst. to the city engineer was referred to me.

Some four years ago the city installed a line of 12-inch hand-made concrete pipe which had a wash of neat

cement on inside of shell. This is in as good shape as when installed.

Last year the city finished putting in some twenty miles of machine-made pipe, which I believe was as good concrete pipe as ever went into a sewer trench. This pipe was made with as wet a mix as would stand up and allow the forms to be removed as soon as made. We have made frequent inspections of this pipe and find it in good condition, but do not think it has been in use long enough to give a fair test of its durability at the present time.

The city is using concrete pipe almost exclusively for culvert purposes, and find it gives good satisfaction.

Respectfully,
(Signed) F. M. LOCKWOOD,
Assistant Superintendent Sewers.

SPECIFICATION FOR CEMENT TOP FLOORS

This specification is for laying hard finish on new rough concrete, either piling or slabs supported by forms.

Finish to be mixed one part of cement to two parts crushed trap or hard gravel screening, which will pass through a half-inch sieve, and from which the fine dust has been removed. This is to be thoroughly mixed in a mixing box or by a machine mixer, with an amount of water to produce a plastic but not a sloppy consistency; spread on the under-concrete before either the finish of the under-concrete has had time to set, floated with a wooden float to a true level and then lightly troweled with a steel trowel as soon as possible to bring it to proper level and to smooth the top slightly. This will give a finish which is pebbly. It will not be dead smooth or slick like a sand finish.

After the finish had been troweled and has set sufficiently so that the covering will not mar the surface, it should be covered with sawdust, sand, cloths, or any other material which will hold water on it continuously. In building reinforced concrete work, difficulty will be caused by the sand and sawdust blowing about the work filling the forms, and generally getting in the way. In working around a textile mill there is usually plenty of old bagging, and in a paper mill there is usually plenty of old felts which can be borrowed for the purpose of preventing this.

The finish should be kept soaking wet for at least a week, or better for ten days. After two days it is possible to put up studs and do miscellaneous work on top of the new finish, provided it is not allowed to dry out.

CEMENT SILOS.

Concrete has been used to some extent in the construction of concrete silos. The widespread use of the material for silos, however, has been greatly retarded by the lack of contractors ready to build them and to the high cost of building forms. An inexpensive, wooden form has been placed upon the market by the McCoy Silo Form Company, 1301 Berger Building, Pittsburgh, Pa. This form promises to remove some of the obstacles that have interfered with the rapid building of concrete silos all over the country. The McCoy Company have been engaged in silo and in silo form construction for a number of years. The form which they are now offering has been used extensively by the State of Wisconsin and by the U. S. Department of Agriculture in demonstration work in various states.

SMALL CRUSHERS ON CONCRETE WORK

We have a small jaw crusher mounted upon wheels with a gasoline engine, which was purchased primarily for the purpose of crushing the concrete which we removed from the track in the progress of repairs. It has been our practice to utilize this material in making concrete and for ballast as repairs progressed, but the cost of breaking this up by hand was excessive.

This crusher, a "Universal," manufactured by the Universal Crusher Company, 304 North Third street, Cedar Rapids, Ia., is of such size and weight that it can be easily handled by one or two teams from place to place upon the street, so that one machine may cover all of the work necessary for several gangs. Of course, under the circumstances, on account of the broken time, it has been difficult to determine just exactly the cost per yard for this class of work. After the repair season was finished, however, the crusher was placed in the yard where there was a large quantity of concrete, old granite block and brick that had been picked up and removed from the street from time to time, and in order to utilize this, the crusher was put to work breaking it up and loading it, by means of its elevator into cars. It was utilized for ballast on some of our open track. As nearly as we can determine, the cost of this, including labor and gasoline, amounted to 50 cents per cubic yard; and I believe that this would be a fair average of the cost of crushing this material upon the street.

The machine is now being used for the purpose of crushing up the limestone that we removed from some of our cuts on our opened track lines. This is crushed upon the ground and will be utilized in the vicinity for ballast.

We have found such a crusher a very useful machine, writes A. E. Harvey, chief engineer, Metropolitan Street Railway Company, Kansas City, Mo., and it has saved us a great deal of money in the past season. I think it is an economical proposition in any work where quantities of concrete or stone can be again utilized if crushed.

BULK CEMENT

The Chicago, Milwaukee & St. Paul Railroad began an experiment in the handling of bulk cement on track elevation work which marks the beginning of the use of bulk cement in this class of railroad work.

Three cars of Universal Portland cement, shipped to Bloomingdale Road for use in the Milwaukee & St. Paul elevation work on the Bloomingdale division, have already been used and the St. Paul road is considering the use of bulk shipment in several other elevation jobs which are now in process of construction.

The result of the experiment has shown that bulk cement can be handled from the car to the mixer so as to eliminate the work of two men which is necessary for the handling of sacked cement at each mixer and also do away with the work of one man who takes care of sacks at the three mixers on the job.

The Universal Portland Cement Company sold the cement at a price 40 cents less per barrel than would have been charged had sacks been used.

CEMENT BILL LAID IN DUST

Final victory was won today by the cement manufacturers of California, in their fight to defeat Assembly McDonald's bill to compel them to pack cement in dust-proof bags and barrels. The Assembly refused to reconsider by 32 ayes to 42 nays. Senator Bryant has a similar bill in the Upper House, where the fight may be kept going.

THE DUNN CEMENT DRAIN TILE MACHINE

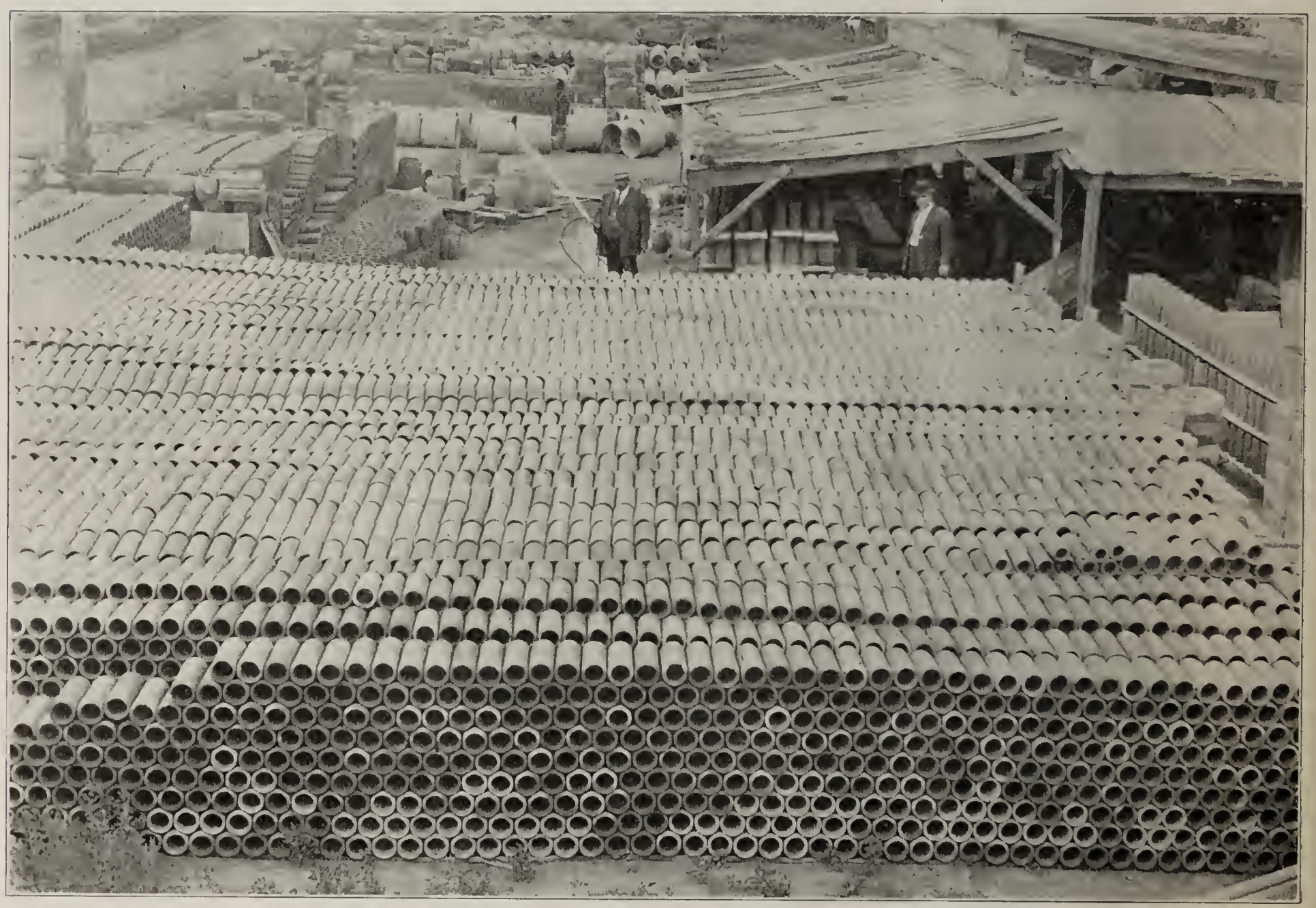
The most successful and widely used cement tile machine on the market today is that made by the W. E. Dunn Manufacturing Company, 4139 Fillmore street, Chicago. It is inexpensive, economical and durable and the company has such unbounded confidence in their machine that they will ship one to any responsible party on 15 days free trial. During this time should you not find the machine as represented, you can return it and all money paid will be promptly refunded. The W. E. Dunn Manufacturing Company guarantee their tile machine for one year, and agree to replace, free of charge, any machine or part of machine that gives out on account of defect in material or construction. They also guarantee that their machines do not infringe on the patents of any other manufacturer or company. That they have been successful and that they have constantly gone ahead, is attributed to their policy of doing business:—namely, to make a good article, sell it at a fair price and stand back of their goods. By adhering to this policy, much of their success has come from re-orders; from customers who have been dealing with them during the last ten years.

"One of the accepted facts in the business world, writes the W. E. Dunn Manufacturing Company, "is that, in these days of large corporations, the chance for the man of moderate means to start in for himself is very small. Right here is the great advantage of the cement drain tile industry. You can start in with one machine, or with ten and SUCCESSFULLY COMPETE both in quality or price with large clay tile factories. There are two reasons for this, your article is superior, and you have no freight to pay. This holds good whether you start large or small. In other words, while there is always room at the top, in the drain tile business there is room at the bottom and all the way up.

"Start with a No. 1 machine, add a mixer, and in a short time you have a nice business, and what is better, a nice profit. The trust sets the price, so you don't have to worry about that; you simply install a Dunn Machine and make a better tile at a lower cost.

"The market is here, ripe and ready. The farmer has only STARTED on the drainage proposition, without a doubt there is ten times as much tile used today as ten years ago, and the demand will keep increasing in proportion. Don't miss YOUR chance to supply this market.

"Cement drain tile is a staple article. The styles never change, and the quality improves with age. No danger of destruction of fire, flood or freezing. No skilled labor required—any able bodied man can run the machine. Simply a good, clean, safe and profitable business."



90,000 CEMENT TILE MADE ON THE DUNN NO. 1 MACHINE.

CONCRETE PIPE FOR EL PASO, TEXAS

After a thorough investigation of the concrete sewer pipe employed in the sewage system of Los Angeles and San Diego, Cal., that pipe will be specified for the new sewer lines to be put down in El Paso, Texas. On account of the high price of the vitrified pipe the city officials of El Paso went to California to make a test of the concrete pipe used there.

SAND AND GRAVEL WASHER

As every worker in concrete knows, or should know, nothing is so important as clean sand and gravel, and these are often hard to get. There is a machine for washing sand and gravel that has solved completely this problem for every concrete man. It is made by the Stocker Concrete Material Washer Company, Highland, Ill.

The Stocker Gravel and Artificial Stone Company has been operating for years, and, feeling the necessity of a device to clean gravel and sand, Mr. F. Stocker undertook to construct one and finally succeeded in inventing the machine, thereby supplying a want generally felt in the concrete industry.

This machine has been tried thoroughly and found to be practical and advantageous in every respect. Its construction is very simple and strong, most durable and comparatively cheap. It can be readily operated by anyone, since there are no complicated parts to get out of order.

The machine can be easily transported from place to place if desired. This feature is particularly advantageous in case of bridge building, pier and abutment work; in such case the machine can be moved to creek or river bank, where sand and gravel can be found in abundance nearby, however usually too much mixed with mud, dirt or other impurities to permit their use; but if washed right on the spot the cost of hauling the material from a distance, sometimes for miles, is saved.

The washer is all metal, the end frames are cast iron, the revolving drum is of No. 16 sheet steel. On the inside of the drum are riveted angle iron bars, to which steel strips are riveted, forming an elevator carrying the material to the upper part of the drum, whence it drops into steel chutes, which are stationary and at a fixed angle, conveying the material forward; from the chute it falls into water at bottom of the drum, taken up by the elevator and dropped into the next chute and so on until the washed material finally is discharged from the last chute.

The machine can be operated with a 2-horsepower gasoline engine, is well made, strong and durable.

The capacity of the machine is about 75 tons per day of 10 hours, washing sand and gravel containing 20 per cent of clay (result of actual tests) and will require only from 10 to 15 gallons of water per minute. Then, too, the price is within the reach of all. Write them today for prices, catalogues and mention Cement & Engineering News.

THE U. S. STANDARD BLOCK MACHINE

Speed, simplicity, durability and versatility are some of the virtues claimed for the U. S. Standard Block Machine by their makers the R. R. Reed Company, Ashland, Ohio. These machines have been improved and the 1913 models contain many little points of advantage not embodied in those of earlier design.

The company asserts that when a man buys a U. S. Standard Block Machine he has gone a long way toward equipping a complete concrete products plant, for the reason that one machine, with its various attachments, can be made to produce hollow block, veneer block, circular blocks, broken ashlar, chimney blocks, porch piers, door and window frames and angle blocks of any desired angle. In fact it can make any block necessary for a modern building.

The U. S. Standard Block machine is a face down machine built in 16 and 24 inch sizes. It builds the strongest block. Instead of cutting out one or two large openings, it cuts from four to six small oval cores, leaving a cross support or bond every four inches throughout the length of the block preventing any possibility of the block sagging or collapsing while green.

The cross bond also enables us to use every wet material, giving us the full value of the cement, and making a very dense block, not likely to absorb moisture, says Mr. Reed. The "Junior" or 16 inch block machine will make blocks 4, 8, 12 and 16 inches in length; and 3, 4, 5, 6, 8, 10 and 12 inches in thickness of wall. All sizes can be built solid, if desired. The 6, 8, 10 and 12 inch blocks are usually built hollow using less material and producing a ventilated wall.

The "Senior" or 24 inch Block Machine will make

all the different kinds of blocks that can be made on the 16 inch machine and in addition 20 and 24 inch blocks. The 16 inch machine can be successfully operated by one man, while the 24 inch machine is a two man machine.

The 1913 catalog No. 21 illustrating this block machine will be sent to any of our readers by writing R. R. Reed Company, Ashland, Ohio. Their Bulletin No. 21 also contains interesting and useful data concerning the manufacture and sale of concrete blocks.

A NEW SIMPSON CONCRETE PORCH BOOK

The Simpson Cement Mold Company, 187 West Maple street, Columbus, Ohio, has just issued its "Concrete Porch Book No. 8." It is the most elaborate catalogue the company has ever put out and it shows a constant and rapid increase in the number and variety of Simpson molds, of which it illustrates many new ones produced during the year since the last previous catalogue was printed.

Combined with the book are the practical directions for porch construction which had previously appeared in a separate publication of the company entitled "How to Build Fine Concrete Porches." The demand for these instructions has been very great and many thousand copies have been mailed upon request by the Simpson Company.

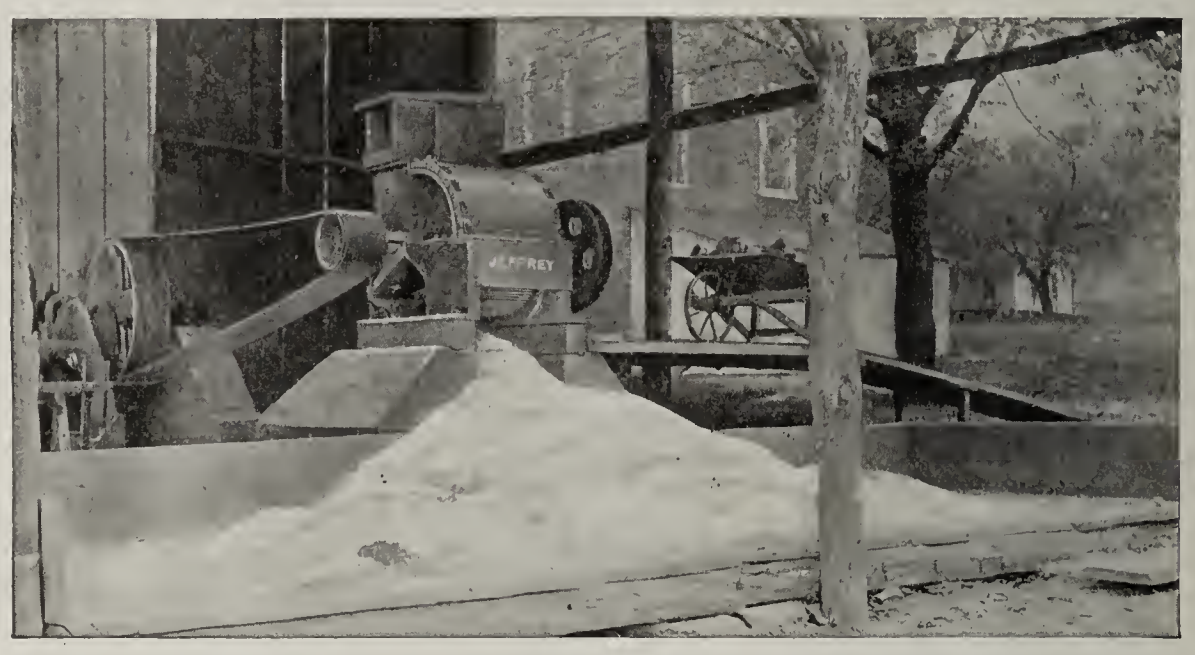
The "Concrete Porch Book" also contains a large number of new engravings of finished verandas and other structures to which designs from Simpson molds were used. One of the most notable of these is a pergola on the estate of Mr. J. C. Campbell, in Licking county, Ohio, in which ninety-six columns were used, made in the Simpson pergola column outfit.

A further indication of the increasing business of the Simpson Cement Mold Company is the fact that it has again been compelled (the fourth time in the past five years) to increase its facilities and has taken new and much larger quarters in Columbus for the manufacture of its molds. The new location is at 187 West Maple street. Requests for the new literature will receive prompt attention.

GROUND LIMESTONE FOR AGRICULTURAL PURPOSES.

The demand for pulverized limestone for agricultural purposes has become so great that we are putting out a line of machines especially suitable for this work. Where it is desired to establish a permanent mill to which the raw stone may be hauled for the purpose of grinding, we offer any of our Type A Machines. These machines are usually placed on permanent foundation and belted from a line shaft or steam engine writes the Jeffrey Manufacturing Company, Columbus, Ohio.

The whole installation may be set out in the open as shown by the illustration herewith, or it may be enclosed in a suitable building. In the latter case, the equipment should include suitable elevators, conveyers and storage bins for handling the material properly. These plants are always special, being designed to suit local conditions. Our engineers have had a good deal of experience along this line. It might be advantageous to consult them on such designs. Such consultation does not carry with it any obligation to buy. At any rate, we are always ready to furnish estimates on any equipment you may desire.



24″x12″ TYPE A PULVERIZER GRINDING RAW LIMESTONE FOR AGRICULTURAL PURPOSES.
Manufactured by the Jeffrey Mfg. Co., Columbus, O.

THE ALLIS-CHALMERS MANUFACTURING COMPANY

On April 16, 1913, the Allis-Chalmers Manufacturing Company took over the properties and entire operation of the business of the Allis-Chalmers Company, which latter company during the past year has been in the hands of a receiver. This change marks the end of the Allis-Chalmers receivership and the commencement of the administration of the new company.

Beginning with April 16th all business has been and will be conducted by the Allis-Chalmers Manufacturing Company, which starts out under conditions promising success. The new company will operate all departments of the business as conducted by its predecessor and will carry out all contracts on hand for the sale of its products. It has no bonded indebtedness nor liabilities of any character. In addition to all assets of the former Allis-Chalmers Company the new company has over four million dollars additional cash for new working capital which has been raised through the recent reorganization.

The new company will continue to operate the large West Allis Works and Reliance Works at Milwaukee, the Chicago works, and in addition will control the operations of the Bullock Electric Manufacturing Company at Cincinnati. Otto H. Falk, of Milwaukee, who for the past year has been receiver of the Allis-Chalmers Company and under whose management as receiver the operations of the business have shown marked improvement, has been elected president of the new Company, the general offices will be at Milwaukee.

All properties of the new company are in good condition and its inventories and working capital on a sound basis. Its engineering departments are well equipped and the various lines of product now turned out are of the highest quality. Under these conditions it is believed that with the present careful and intelligent management the operations will show substantial profits.

LOADING SAND BY STEAM SHOVEL

Walter Reisgen, superintendent of the Pittsburg Plate Glass Company's sand plant at Kittanning, Pa., lately purchased a Marion steam shovel for loading the sand in cars. The shovel is the latest pattern manufactured by the Marion Steam Shovel Company, Marion, Ohio.

THE MARION STEAM SHOVEL COMPANY

The plant of Marion Steam Shovel Co., which occupies 75 acres, is much the largest industry of the thriving town of Marion, O. The plant has the remarkable record of having worked continuously day and night for the past six years. Notwithstanding the fact that it already employs some 3,500 men, six men are on the road, on the lookout for additional men to the extent of 1,000.

The Marion Company, which is the pioneer in the steam shovel line, makes excavating and dredging machinery of all kinds. It recently shipped to the Alaska gold fields two immense hydraulic dredges, which required 140 freight cars for shipping, and sold for the total sum of $1,700,000.

The Marion shovels are especially remarkable for their flexibility and the ease with which they may be adapted to various uses. In their ad., appearing elsewhere in this issue, is shown the Marion Model 250 Revolving shovel for stripping over-burden from stone quarries. This machine is provided with an extra long boom for making wide cuts and dumping the excavated material far enough to one side so that the rock or stone thus uncovered may be taken out without being partly under the spoil bank. This eliminates the handling of the over-burden in cars and reduces the labor required to the shovel crew.

M'CORMICK WATERPROOFING IN BURLINGTON BUILDING

The accompanying illustration shows the magnificent office building recently erected in Chicago by the Chicago, Burlington & Quincy Railroad. This is located at the corner of Jackson boulevard and Canal street, and covers a ground space of 50 x 175 feet. It is of particular interest because of the fact that 2,000 barrels of cement waterproofed by the McCormick process was used in the sub-basement construction.

This was furnished by the Chicago office of the McCormick Waterproof Portland Cement Company, 1112 Chamber of Commerce building. The building was designed by Marshall & Fox, and the general contractors were James Stewart & Co. Mr. H. C. Morrison, 1112 Chamber of Commerce building, Chicago, the local manager of the McCormick Waterproof Portland Cement Company, shall be glad to furnish, free of cost to readers of Cement and Engineering News, any information, catalogs, samples or data on waterproofing problems, waterproofing cement, etc.

STEEL FORMS FOR SIDEWALKS

The W. B. Jones Boiler Works Company, Streator, Ill., is manufacturing a new system of forms for sidewalks, curbs and gutters. This is known as the Heltzel system, and a notable feature is that no keys, wedges for clamps are used in connecting the forms together. The manufacturer claims that forms can be set up and dismantled without the aid of a hammer. The side rails are adjustable and interchangeable. These forms are provided with a division plate stiffener bar to hold the plates in line while concrete is being stamped. This insures straight expansion points. A self-retaining straight edge is also used in connection with this system. Full particulars can be secured by addressing the manufacturer.

FIRST OPEN AIR NATATORIUM FOR CHICAGO

The first municipally owned "swimming hole" in Chicago is to be opened for Washington Heights and Tracy (106th street) when the bathing season starts. It is an up-to-date natatorium, with diving paraphernalia, hot and cold shower baths, dressing rooms and lockers. It has a capacity of 124,000 gallons, and will be filled with fresh water every day. The work, which is almost completed, has been done entirely by the city and paid for by an appropriation of $10,000 made by the council.

The swimming basin will be 50 by 90 feet, one of the largest in the city. It will have a fresh-air advantage over many others by being uninclosed, the swimmer being able to accumulate as much sunburn and tan as if he trudged the five miles to the lake.

For beginners, one edge of the basin will have only three feet of water, but a depth of eight feet will be maintained at the other end. Four dressing rooms, 160 lockers, bath towels, brushes and combs will make up the side line incidentals. An attendant will look after the property, and provide each swimmer with a two-piece suit to comply with the city ordinance.

The construction of the natatorium has been under the direction of Charles W. Kallal, city architect. Twenty-nine clusters of electric lights are to be installed, when it will be ready to turn over to the park commission.

City property at One Hundred and Third street and Vincennes road, now partly used by the pumping station on one side and a fire engine house on the other, was chosen as the site of the natatorium. The fire station is not more than fifteen feet from the water's edge, which makes the parents of the children feel safe about them.

"A municipal natatorium is the only thing," said Commissioner of Public Works McGann. "The city ought to have more of them, scattered in spots far from the lake. I believe every pumping station which the city constructs from this time forward should have a natatorium for the public as part of it. I have given orders that no plans for new pumping stations be drawn during my administration without a natatorium adjoined. When the city has the property and the water, and the people want it, give it to them."

The walls are entirely above ground, are waterproofed with McCormick Shamrock brand waterproof

compound and show no signs of water seepage or leaks. Prices, samples and catalogs of McCormick waterproof cement may be had by addressing H. C. Morrison, 1122 Chamber of Commerce building, Chicago, local agent, and by mentioning Cement and Engineering News.

CAR SHORTAGE

If every big shipper could see the car shortage situation in the proper light it would be possible to relieve to a great extent the yearly shortage, without a large increase in the present number of cars. The loading of cars to less than allowable capacity cuts down the efficiency of the railroads more than any other single item. During 1912 the Universal Portland Cement Company, saved 2,136 cars out of the country's car supply by increasing the average load per car. In other words, a demand for 2,136 more cars would have been made by this company in order to ship its output if the conditions in 1911 had not been radically changed by the increase in average loading.

The salesmen of the company are finding it readily possible to book orders for full carload lots rather than the old quantities of 100, 150 and 250 barrels. The buyer can just as readily handle a car of 144, 173, 231, or 287 barrels, maximum an efficient loading.

Considering that one shipper saved 2,136 cars during the average period of shipment in 1912 it would seem that similar energetic work on the part of other shippers might result in more satisfactory traffic conditions and that too without additional investment on the part of the railroad companies in rolling stock.

While there is no compulsion from the railroads to make full tonnage shipments yet it is to the interests of the shippers themselves to make efficient use of the railroad's car supply and the benefit will accrue directly to the shippers.

ARCHITECTURAL APPEARANCE OF WAREHOUSES

The architectural appearance of a warehouse is something which often receives scant attention and sometimes presents real difficulties. Numerous examples might be given of buildings of this class where the aesthetic features have not been entirely neglected. Notable among these is the warehouse of the Massachusetts Cotton Mills at Lowell, Mass., designed by Lockwood, Greene & Co., Boston, which has the appearance of the best class of office building. This result was obtained by brick paneling, the grooving of the surface of the concrete on the first three floors and a heavy concrete cornice.

A small amount of ornamentation in the way of simple mouldings, surface treatment of concrete, brick panels or pilasters, adds materially to the appearance of a warehouse and the added expense is negligible.

STRUTHERS CEMENT PLANT

The cement plant connected with the Struthers furnace, Struthers, Ohio, will resume operation next week. The company has received a big list of orders and steady operation of the works during the spring and summer months is assured. Slag from the furnace is pulverized and utilized in the manufacture of a fine quality of cement. Resumption of the cement department of the Struthers furnace will provide employment to a number of additional workmen.

LOADING ROCK BY STEAM SHOVEL

The United Kansas Portland Cement Company, Iola, Kansas are using a Model 60 Marion steam shovel, manufactured by the Marion Steam Shovel Company, Marion Ohio, for loading rock in cars at their plant in Independence, Mo.

A LARGE CONCRETE BRICK PLANT FOR SALT LAKE CITY

The announcement of the recent filing of articles of incorporation in the name of the Enamel Brick and Concrete Company, under which articles this company is to take over all the assets and liabilities of the original Concrete Brick Company, has led to the erroneous conception that there has been an amalgamation of the newly incorporated concern with the Utah Glazed Cement Pipe Company. As a matter of fact no such amalgamation has taken place. The Utah Glazed Cement Pipe Company is a separate company and is in no way allied with the Enamel Brick & Concrete Company, although both companies draw from the same sources for supplies, and the general management of the companies has been in the same person, and is likely to continue so.

The new organization of the Enamel Brick & Concrete Company provides for an increase of capital with ample funds for the continuing of the business, and for its extension along several lines that are regarded as particularly promising. The management reports that the plant has been operating night and day for a few months past, turning out nearly a million bricks of different colors for the new high school. Its white brick are also being used in the main building at the University of Utah. The extensive sand deposits owned by the company at Sandy, Utah, located on the D. & R. G., are now being equipped with screening and loading facilities, which will increase the capacity about 10 times.

CEMENT ROOFING TILE

The American Cement Tile Manufacturing Company of Pittsburg has been awarded the contract by the government for about 650,000 square yards of reinforced cement tile for covering the roofs of the sixteen new shop buildings at Balboa, on the Pacific side of the Isthmus of Panama. The tile will be manufactured at the site under government inspection. That cement tile should have been selected for this work speaks well for them since the heavy rains in Panama will put any roof to a most severe test. Cement tile have proven their fitness under actual conditions in government tests.

CONCRETE CISTERNS

An interesting type of cistern is being built and marketed by the Patent Concrete Cistern Company, of Grand Forks, N. D. The cisterns are built in the company's yard and subsequently placed in excavations made of the proper size. The construction is novel and seems destined to replace cisterns of other materials.

Another interesting novelty which this company builds of concrete is a pork barrel which, it is claimed, is almost as cheap and much longer lived than the old-fashioned stave barrel.

KILLED IN QUARRY BLAST

Eleven men were killed by a premature explosion of 1,000 pounds of dynamite last week in the quarries of the Riverside Portland Cement Company at Riverside, Calif. The bodies of five have been recovered, including that of Gus Olson, powder foreman.

SUCCEEDS AMERICAN CEMENT COMPANY

Philadelphia, March 6.—A charter has been granted at Dover, Del., for the Giant Portland Cement Company, successor of the American Cement Company, with $2,000,000 7 per cent cumulative preferred and $2,000,000 common stock.

NEW BOOK

The Universal Portland Cement Company, 72 West Adams street, Chicago, is distributing a new book, "The Concrete House and Its Construction," published by the Association of American Portland Cement Manufacturers. It has 224 pages, 159 illustrations and is sold for $1.00 per copy. The index of chapters indicates its scope.

1—The advantages of concrete for House Construction.

2—Architectural Design and Treatment of Concrete Houses.

3—Details of Construction.

4—Operations in the Field.

5—Calculations for Determining the Strength and Design of Reinforced Concrete in House Construction.

6—Calculating the Bending Moments for Reinforced Concrete Beams and Slabs and the Determination of Size and Reinforcement.

7—Tables for designing Reinforced Concrete Construction and Their Use.

8—Concrete Block Houses.

Persons desiring the book will receive one prepaid by sending $1.00 to the Universal Portland Cement Co., Chicago, Pittsburgh or Minneapolis.

BOOK REVIEWS.

There is perhaps no name more familiar to manufacturers of Portland cement than that of Richard K. Meade, the chemist, who has had such a large part in the development of the Portland cement industry in the United States. Mr. Meade is now general manager of the Tidewater Portland Cement Company.

His book, entitled "Portland Cement," which takes up its compositon, raw materials, manufacture, tests and analysis, is one of the standard volumes in the industry and will be for some time to come, since it has just been revised down to date and the second edition has been issued by the publishers, the Chemical Publishing Company.

In this second edition the entire text of the book has been revised and much new matter has been added, particularly to the section on manufacture, which has been increased about 70 pages. This has been made necessary in order to include descriptions of all the newer appliances for the manufacture of Portland cement, making this department fully representative of the present state of the industry. The other sections of the book have also been revised correspondingly, bringing them up to date.

The book as revised comprises over 500 pages with a large number of illustrations and complete index. The price is $4.50, and will be sent by Cement & Engineering News, 1117 Schiller Bldg., Chicago, Ill., on receipt of price.

NEWS ITEMS

John Hanft, Columbus Grove, Iowa, has been busy this spring at his cement factory, in addition to his regular cement work, turning out cement blocks and the foundation of the new home of F. M. Molsberry is evidence of some of the new and very attractive methods of making these blocks. The blocks are finished on the outside with white cement and make one of the finest and most artistic foundations ever seen.

Moline Cement Products Company, Moline, Ill., recently incorporated for $20,000 to manufacture cement products.

Among The Cement Mills

A CORRECTION.

Tidewater Portland Cement Plant.

Referring to the write-up in the April issue of Cement & Engineering News concerning the new Tidewater Portland Cement Company's cement mill and hydrating lime plant, we failed to state that these plants were designed and erected by the Fuller Engineering Company of Allentown, Pa. Every single plan, blue print and detailed drawing for both of these plants were made in the office of the Fuller Engineering Company, who also had the contract for the construction of the mills.

VALUABLE PETOSKEY INDUSTRY

The Petoskey Crushed Stone Company, which has sold its lime plant at Bay Shore to the Michigan Lime Company, operates one of the largest crushed stone plants in the state at Crusherville, near Petoskey. This plant will increase its output this year. The company claims to have the best limestone in Michigan for road work, and it supplied 22,000 tons of crushed stone which were used on highways in Michigan in 1912. Blast furnaces used 59,000 tons and the Newaygo Portland Cement Company 65,000 tons.

Since the plant has been in operation the company has shipped 1,200,000 tons of stone, or 31,600 carloads. The company's plant is very complete. It employs 35 men at Crusherville and its payroll last year was $12,750.

The reports submitted at the annual meeting were of a highly gratifying nature. The old board of directors, consisting of S. L. Robinson and Homer Sly, Petoskey; E. R. Sly, Bay Shore; M. B. Lang and Harry Hirshberg, Elk Rapids, and S. E. Wyland. Chicago, was reelected. Officers: President, S. L. Robinson; Vice President, E. R. Sly; Secretary, Treasurer and General Manager, Homer Sly.

Cement shipped from the United States to Hawaii during seven months ending January 31, 1913 was valued at $207,281.

Porto Rico imported from the United States, 226,041 barrels of cement valued at $295,560 from July 1, 1912 to January 31, 1913.

The Philippine Islands imported only 125 barrels of cement from the United States, valued at $155, from July 1, 1912 to January 31, 1913. The cement supplies for the Philippines is drawn from Macao, China and Japan.

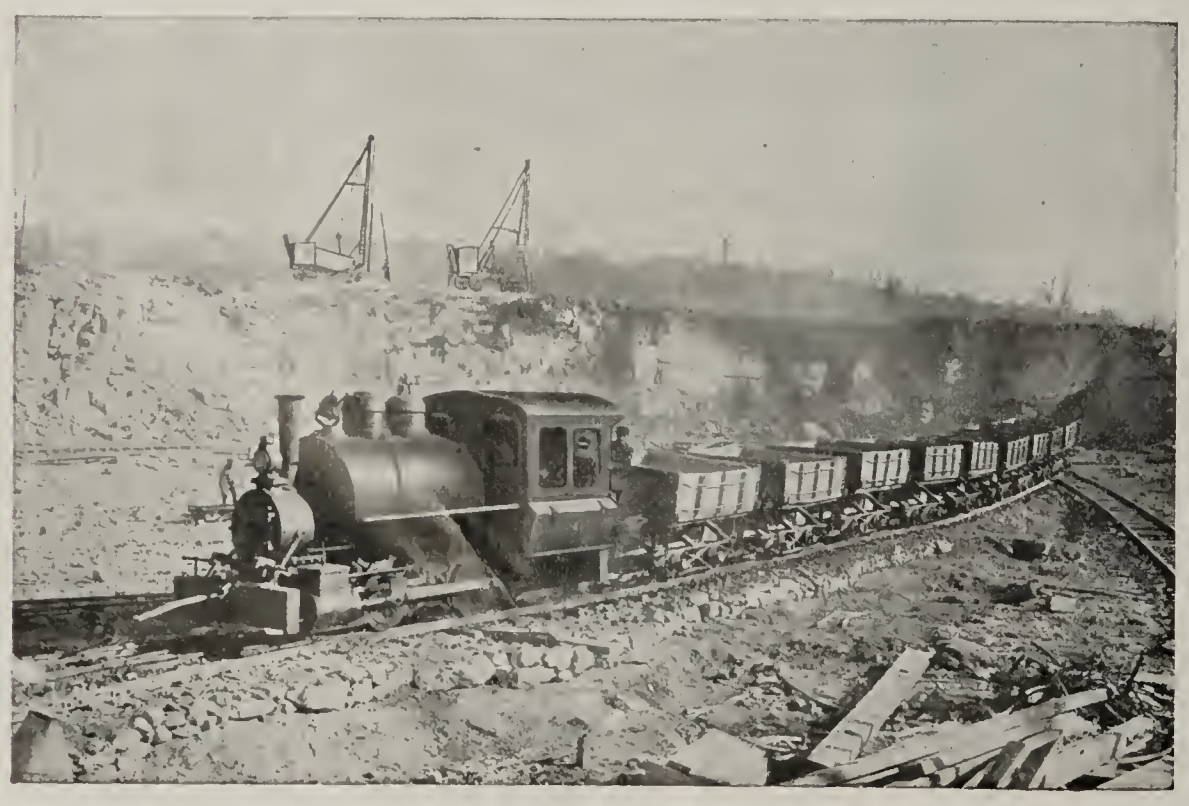
Sixty-one thousand seven hundred and fifty-one dollars represents the value of Portland and Hydraulic cement imported into the United States for seven months ending January 31, 1913, a decline of $71,274 for the same period ending January 31, 1912.

A saving of approximately $3,500 a year to the city in the purchase of cement was effected by the Administration Board yesterday, says the Richmond, Va. Leader, provided the new brand will stand the analytical tests to be made on its arrival in Richmond. The board awarded the annual contract for supplying the city with cement to Stephen A. Ellison Company for 20,000 barrels, more or less, of Tidewater Portland cement, at its bid of $1.46, in wood barrels, or $1.49 in bags, the city to have a rebate of 10 cents for each bag returned. There are four bags to a barrel, and if proper care is taken by contractors, the net price to the city of the cement will be $1.09, by far the lowest price at which it has ever been purchased on a city contract.

The contract specifies as a condition that the cement furnished must meet all standard tests and requirements on delivery in Richmond.

QUICK SETTLEMENT

In the Superior Court of Riverside county last week the first case ever tried there under the provisions of the Employers' Liability Act resulted in judgment in the sum of $2,000 for the widow of Steve Kuznjock, an Austrian laborer in the Riverside Portland Cement Company's quarry, Riverside, Calif., who was killed by the accidental explosion of dynamite January 20th. The case was tried, judgment awarded, and a check received by the widow, all within a few minutes.



Dinky Locomotive hauling dump cars in the quarry of the Chicago Portland Cement Company, Oglesby Illinois. Armstrong Churn Drills in backgrounds.

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SERVICE
CONVEYOR BELT
SPECIAL

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Among The Cement Mills

PORTLAND CEMENT TO ADVANCE

A dispatch from Chicago that is of considerable interest to Michigan states that if the cement manufacturers of the country are to remain in business, it is certain that users of the product, will, henceforth, be obliged to pay higher prices, according to competent engineers and auditors, identified with the industry, who maintain that Portland cement has been sold below cost of production, for the past ten years.

H. Struckmann, of Kansas City, Mo., declares that the cost of producing a barrel of Portland cement is $1.06. Last year the production of Portland cement in the United States approximated eighty-two million barrels, and the average selling price at producing points did not exceed sixty-five cents, representing an actual loss to the manufacturers of somewhat more than 33½ million dollars.

The condition is due to ignorance on the part of the manufacturers, who in the past have failed to observe the fact that the machinery and equipment of their plants require replacing every twenty-five years and, consequently, no fund was created to offset this tremendous expense.—Michigan Manufacturer.

RATE DISCRIMINATION

A decision in favor of the complainant was today rendered by the Interstate Commerce Commission in the case of the Texas Cement Plaster Company against the St. Louis & San Francisco and other railroads. In this case it was alleged that the failure of the Kansas City, Mexico & Orient and the St. Louis & San Francisco railroads to establish joint through rates on cement plaster from Plasterco, Tex., to destinations on the line of the St. Louis & San Francisco results in a discrimination against the products of the complainant. The Commission ordered the roads to put into effect by June 1 joint rates between these points not exceeding similar rates contemporaneously charged from Acme, Tex., to the same destinations.

GIANT PORTLAND CEMENT

The recently elected board of directors of the new Giant Portland Cement company met at the offices of the company yesterday in the Pennsylvania building, Philadelphia, for the purpose of organization. The directors of the new company are Messrs. Edward B. Smith, Robert W. Lesley, Charles F. Conn, Charles J. Rhoades, Evan Randolph, Charles Scott, Jr., Frank H. Clement, Gerald Holsman, Winthrop Sargent, Claude A. Simpler and William J. Maloney .

The officers of the company are as follows: Charles F. Conn, president; Charles J. Rhoades, vice president; Robert E. Griffith, vice president in charge of sales; Joseph F. Lennig, secretary, and F. J. Jiggens, treasurer.

The board of directors at yesterday's meeting also appointed the following executive committee: Messrs. Edward B. Smith, Charles Scott, Jr., Robert W. Lesley, Charles J. Rhoades and Winthop Sargent. The president of the company, Charles F. Conn, is an ex-officio member of the executive committee.

The Giant Portland Cement company was recently organized under the laws of Delaware, and has taken over all the property, mills, lands and business affairs of the American Cement company and its subsidiaries. It has large holdings of lands in Pennsylvania, New York and Virginia. The mills of the company in the Lehigh region are in full operation.

It is expected that the securities of the new company will be ready for delivery about May 1.

CANADA CEMENT COMPANY

At the annual meeting of the Canada Cement Company, held in Montreal, two new members were added to the Board of Directors, which now consists of the following gentlemen: Hon. W. C. Edwards, president; Hon. Robert Mackay, Hon. Geo. A. Cox, Messrs. J. M. Kilbourn, W. H. E. Bravender, C. C. Ballantyn, G. E. Drummond, R. W. Kelley, W. R. Warren, F. P. Jones, E. M. Young, Farquhar Robertson, Denis Murphy, Wm. McMaster and H. L. Doble.

New Bishop Patent Excavator on Guy Derrick, for Digging Gravel. Manufactured by Union Iron Works. . .

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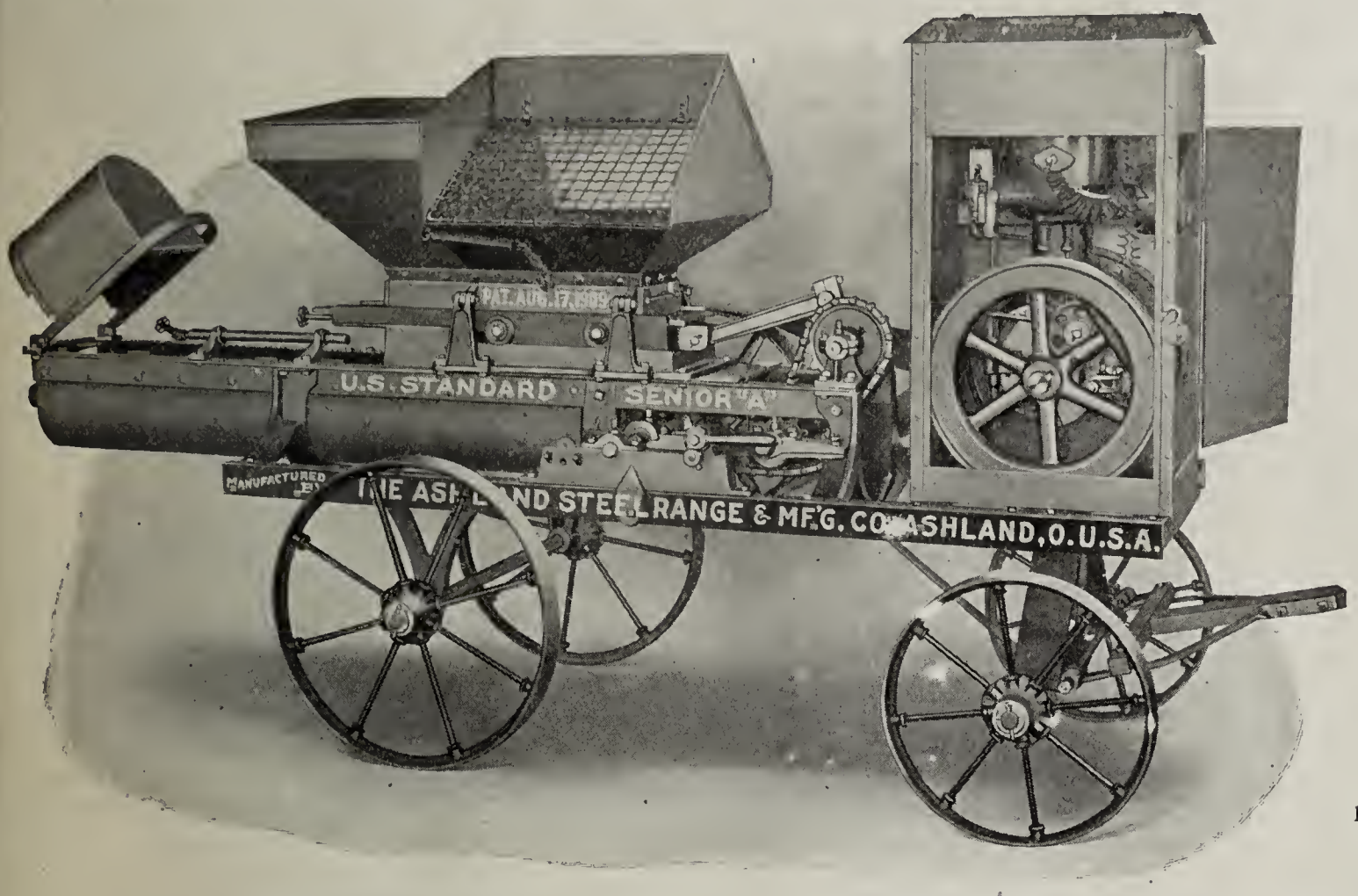

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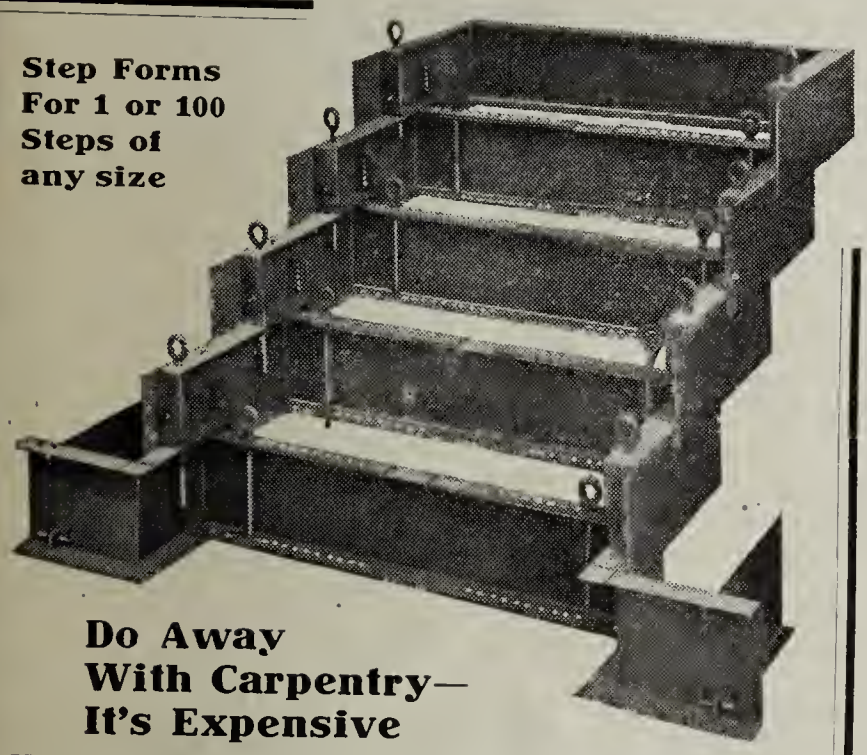

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You can't afford to waste time on wooden forms if you expect to do your share of concrete step construction this season. No two sets of steps are alike in dimensions, and to build new forms for each job, it would require a big share of your time and profits. Before the season sets in, better look into the merits of the

Indiana Adjustable Step Molds

Adjustable to all sizes, enabling you to use the same forms on hundreds of different sized jobs. They are complete in themselves, not simply form holders, but a complete set of molds for molding concrete steps.

Circulars and prices on request.

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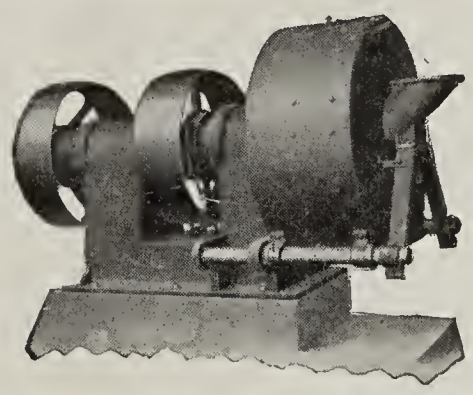

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Among The Cement Mills

NEW CEMENT PLANT AT TRIDENT, MONT.

At a point in Montana where the Jefferson, Madison and Gallatin rivers join in forming the head waters of the Missouri river, the Three Forks Portland Cement Company have completed and are now operating their cement plant at the village of Trident.

The material consists of low lime and shale and lies in a high ridge and very accessible. The quarry is opened up along the face of this ledge for a distance of 1,500 feet, where both high and low rocks lie together.

The quarry outfit consists of a 75-ton steam shovel, 5-ton standard guage cars, which are handled by a 20-ton saddle-back locomotive.

The crusher house is at the ledge and is equipped with No. 9 and No. 5 McCully crushers. From the crusher the rock is carried by Caldwell & Sons' inclined pan conveyor and elevator to the blending rooms, which are located in the storage bins, from which the rock is drawn and weighed under the chemist's instructions and is conveyed to the dryer, which is furnished by the Vulcan Iron Works, Wilkes Barre, Pa., and the rock is dried with gas generated by the Duff Gas producer.

From the dryer-house it is taken by Bartlett & Sons' inclined conveyor to the storage bins through the preliminary grinding mills, which are Lindhardt kominuters, manufactured by F. L. Smidth & Co., 50 Church street, New York. The finished grinding is done by F. L. Smidth Ball and Tube Mills, equipped in such a manner that all grinding machinery can be turned onto raw material or onto clinker. From this building the material is carried by screw conveyors to the kiln room, in which are installed two 150x9½ feet Vulcan kilns.

After leaving the kilns, the hot clinker is conveyed by the conveyor to the coolers, where bucket conveyors take it to the clinker pile and belt conveyor to the grinding bins.. The cement is conveyed from the grinding room to the stock house by a belt conveyor.

The entire plant is electrically driven. The motors, running from 5 to 200 horsepower. The electric power is supplied by the Madison River Power Company. Their wires carry 50,000 voltage and step down at the plant to 440. The entire plant is built with a view of being so arranged that there will be as little conveying machinery as possible and to give opportunity for a thorough testing of the materials and storage in such a way that an absolutely uniform mix can be obtained. No expense was spared in getting the plant as efficient and economic a possible. The coal mill is equipped with two No. 44 Fuller mills.

On account of the location the company was compelled to build a village, which consists of a commissary and store hotel and dwellings for all the men. All of the buildings are built of concrete and are thoroughly modern—lighted with electricity and connected with sewer, which makes it a model village.

FEDERAL SUIT

New indictments against the Empire Portland Cement Company, a $2,500,000 corporation, are being sought before the federal grand jury on charges of using the mails to defraud.

In December, 1912, indictments were voted against four of the alleged promoters of the concern, but they were quashed. Attorney General McReynolds has asked District Attorney Wilkerson to reopen the case and the grand jury for several days has been considering the evidence.

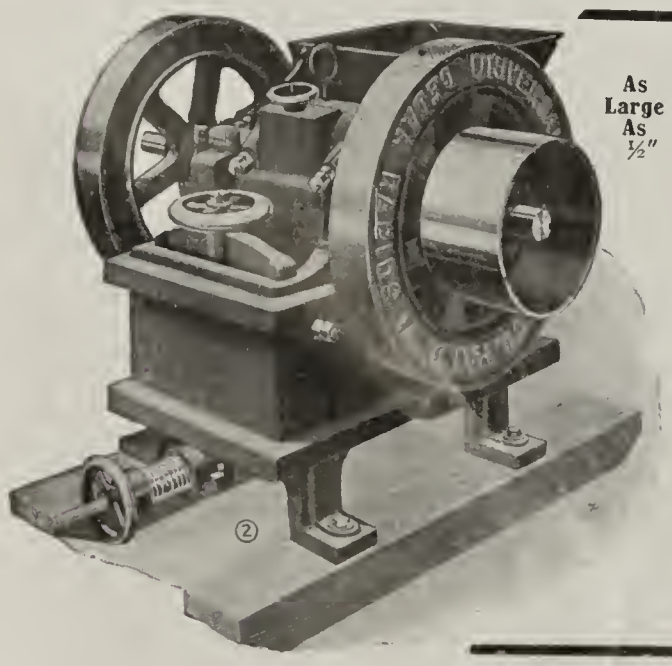
The four men who are alleged to be at the head of the corporation are:

Albert H. Marshall, Chicago, secretary; Harry W. Williams, Sheybogan, Wis., treasurer; Albert G. Kirk, Shell City, Mo., sales agent; Arthur G. Marshall, New York, sales agent.

The government claims the four promoters of the concern swindled cement dealers throughout the country out of more than $120,000 through an alleged cooperative scheme.

The promoters claimed to own big plants at Portsmouth, Ohio, Menominee, Mich., and other cities, and to manufacture the "Setter brand" of cement, it is charged. The York Portland Cement Company of Portsmouth was alleged in literature to be one of the corporation's subsidiary plants. In reality, it is charged, the Empire company had paid but $25,000 as part payment on the plant, instead of $167,000, as the literature claimed.

The government asserts that the corporation's purpose was a "blue sky" stock selling proposition. Each purchaser of stock was promised a bonus in the form of cement to the value of his stock subscription and after the corporation began operating he was to receive a big discount on all purchases of cement. The government claims that the corporation misrepresented its assets and also failed to make good on its proposals to stock purchasers.—(Chicago Herald.)



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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

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CHICAGO, JULY, 1913

WATERPROOFING OF CONCRETE

A long time before special compounds were known for waterproofing cement, hydrated lime was used for this purpose. However, the desired result was obtained only imperfectly and only under certain conditions; moreover, it took a longer time for this lime-cement mixture to become impervious to a certain degree, a fact which made the application of it almost impossible, as in practical use water can mostly not be prevented from coming in contact with the concrete during the setting period.

The cause of the admission of water into the interior of concrete is the existence of air spaces, that is to say of pores through which the water is pressed by exterior pressure or by capillary attraction. That such pores cannot possibly be excluded can readily be seen from the fact that cement must be gauged with more water than is able to chemically combine with it. The surplus water evaporates in time and thus causes pores to form. This deliberation shows that an admixture of finely powdered minerals, which is frequently practiced, can never fulfil the purpose for which is is intended, namely, filling of the pores or reducing of their diameter to such an extent that water will no longer penetrate.

Modern waterproofing compounds can be divided into two classes, those which waterproof the concrete throughout and those which render only the surface impermeable. The latter have the disadvantage of being applicable only to dry walls, a condition which cannot be fulfilled where water exists; besides, they are unable to withstand water under pressure and can, consequently, be used only in cases in which concrete has to be protected from rain.

Reliable waterproofing compounds belonging to the former class must act partly chemically and partly mechanically. Under conditions obtainable in laboratory experiments, but never in practice, cement, without admixtures, can gradually be made waterproof in mixtures of 1 cement to 3 sand or even 1 cement to 5 sand, namely, by subjecting a slab composed of these mortars to a very low pressure in the beginning and by increasing the pressure, very slowly. The water percolates in the beginning, but, on its way through the mortar, dissolves some of the ingredients, mainly calcium hydrate, which latter is recarbonated upon coming in contact with the air and thus made insoluble at the same time closing the pores. An admixture of calcium hydrate, therefore, would merely increase the percentage of soluble ingredients and fill the pores somewhat faster. However, this process goes on too slowly where water under pressure is to be encountered. In the latter case a real waterproofing compound has to be resorted to.

A genuine waterproofing compound acts by offsetting capillary attraction within the pores, that is to say, by, as far as possible, preventing the water from adhering to the walls of the pores. This property of the waterproofing compound is sufficient in the case of lower pressure or humidity; but, where higher pressure prevails, chemical action on the order of the recarbonation of the hydrated lime previously described has to be added. Therefore, a waterproofing compound must, even in the case of high pressure, permit the water to penetrate the concrete only far enough to allow the dissolved ingredients to become again insoluble before they reach the surface of the concrete opposite to the water. This explains the fact, proven by experiment, that the imperviousness increases with the time (independent from the increasing hardening of the cement) by steady filling of the pores with mineral substances. Consequently the action of a reliable waterproofing compound is not of a transitory nature.

The foregoing, furthermore, makes clear that a waterproofing compound, in order to be effective, must be in a fine state of subdivision so that it may be intimately mixed with the cement with the view to not impairing its strength. This object can best be obtained by dissolving the waterproofing compound in the water used for gauging the cement or by keeping it in suspension in the water or by obtaining an emulsion. A good waterproofing compound renders also lean cement mortars and concrete waterproof, whereas an admixture of calcium hydrate is able to render only rich mortars impervious and these even only under proper manipulations, for the pores increase with the increasing percentage of the sand, and the solution of calcium hydrate necessarily passes through the pores so quickly, as capillary attraction is not decreased or offset, that the transformation into carbonate of lime takes place only on the outside after the water carrying the calcium hydrate in solution has passed through the whole thickness of the concrete.

CERESIT WATERPROOFING CO.

The latest catalogue of the Ceresit Waterproofing Co. of Chicago is called their international catalogue because it describes and illustrates buildings in all parts of the world that have been waterproofed with their famous waterproofing compound.

There is no country of importance and no class of building in which this compound has not been tried and given the best of satisfaction. Palaces and hotels, postoffice buildings and railroad stations, water towers and bridges, vaults and aqueducts, lighthouses and warehouses, tunnels and swimming pools, all are found among the constructions subjected to the waterproofing methods of the Ceresit Waterproofing Co.

ELEPHANT BUTTE DAM

The U. S. Reclamation Service is now constructing with its own forces a storage dam across the Rio Grande at Elephant Butte, New Mexico. This dam, together with the dike located about 1¼ miles to the northwest, will form a reservoir with a capacity of 2,600,000 acre-feet. The dam is of the gravity type, straight in plan, built of concrete in which will be embedded rough stones of various sizes up to about 4 cubic yards each. The height of the dam above the original river bed will be 200 feet. Its crest length will be 1200 feet, with a roadway along the top. The faces of the dam below the coping will be of concrete, built in place with the use of sectional forms. The dam is being constructed in accordance with the governmental specifications, some of the provisions of which are outlined below.

Excavation

Excavation is carried down to a sufficient depth to secure a foundation on sound ledge rock, free from open seams or other defects. The masonry is built against the sides of these excavations, and to preserve the rock outside of these lines and at the same time obtain a rock surface free from seams and cracks over the whole foundation, unusual precautions are taken. The specifications require that blasting be done with explosives of moderate power, and whenever liable to injure the foundations, the explosives are abandoned and the rock removed by wedging and barring. A cut-off trench about 15 feet wide and 15 feet deep extends across the base of the dam just below the upstream side.

All rock surfaces are left sufficiently rough to bond well with the masonry. Before laying any masonry on the rock, the latter is thoroughly cleaned. All springs are piped and grouted or carried outside the dam. Smaller seams and cavities are scraped, cleaned out and filled with rich concrete or mortar rammed in under pressure. Test holes, drilled in the river bed at the time when soundings were made to select the location of the dam, are grouted.

In the center of the cut-off trench a row of holes is drilled; these are to be grouted under pressure after the concrete has been carried up not less than 20 feet above the base of the dam.

Through the body of the dam extends an inspection and drainage gallery, to which double staggered rows of drainage holes or weepers are connected. These drains are of three sizes—at the ends of the dam 8 inches in diameter, spaced 6 feet center to center; at the center, 12 inches in diameter, spaced 4 feet; and in the space intervening, 10 inches in diameter, spaced 5½ feet. These drainage holes are carried all the way down to the foundations. If, after the completion of the dam, it should prove that the discharge of one or a number of these holes below the gallery is excessive, and that the discharge continues to increase, it may then be advisable to close up such holes by pumping grout under pressure into them.

Rio Grande Project, New Mexico, Elephant Butte Dam Site. Cableways carrying shifting engine across the Rio Grande. Nine million dollars for moisture. (Courtesy The Paper Trade Journal, New York.)

Concrete

The concrete is made of river sand, crushed rock and cement in proportions of 1:3:6. Crusher screenings smaller than ¼ inch are added to the river sand to make up the three parts. Rock to be crushed is taken from the sandstone quarries along the railroad.

Upstream from the drainage holes the concrete consists of a mixture carefully proportioned so as to have the greatest possible impermeability. The proportions are determined by mechanical analysis of the ingredients available and by experiments on samples taken from large batches. All classes of concrete and mortar are mixed in batch mixers. Hand mixing is not permitted, except in special cases, and then only in small quantities.

stones. Wherever convenient, smaller stones are embedded in the concrete between the larger ones. This is done with the object of obtaining a monolithic mass of stone and concrete, containing as large a proportion of stone as economical. When concrete surfaces are left long enough to permit the concrete to set, they are roughened by partially embedded large rocks.

At the intervals and depths shown in the drawing, contraction joints, normal to the dam axis, are formed by building the masonry against forms. Each such face is coated with an acceptable material to prevent adhesion to the masonry on the other side of the joint. These joints divide the dam into sections, and as the work progresses alternate sections are carried ahead of the intervening ones. One or more of these

Rio Grande Project, New Mexico, Elephant Butte Dam Site looking north. Top of dam extends from base of one set of cable towers to the other, fourteen hundred and eighty feet. The site selected is in the canyon just below Elephant Butte, a familiar land mark of black basalt, with shape singularly like that of an elephant. At the narrowed point in the gorge there is being erected the Elephant Butte Dam, a structure of rubble concrete having a maximum height of 265 feet, a length on top of 1,480 feet and containing 410,000 cubic yards of material. The spillway will be 200 feet above stream, which represents the height of water against the dam when the reservoir is full.

Pudding stones are inspected as to soundness and hardness. They are of irregular shape, with long, thin projections, and of various sizes. They are thoroughly cleaned by the use of water under pressure and are brushed and wetted before they are placed in the work.

Placing of Concrete

The concrete is carried to the work in bottom-dumping buckets. All stones are joggled with a bar, to settle properly into the concrete, and the concrete itself is worked with suitable tools to force the escape of entrained air or surplus water and to insure the filling with concrete of all spaces around the pudding

sections will be maintained at a lower elevation than the adjacent ones, acting as an additional safeguard against damage by floods.

Special Finish of Surfaces

Except concrete surfaces, for which special finish is required, the exposed faces of coping of wing walls, culverts and other structures will have a smooth finish. If such surfaces are not cast against forms, they will be screeded, troweled and rubbed to a smooth finish. Care will also be taken to avoid discoloration or marks on exposed surfaces. In depositing concrete, all coarse aggregates are carefully spaded away from the surfaces.

Forms

In order to secure the smoothest practicable finished surfaces, wherever the concrete is part of a waterway, the centering, if not entirely of metal construction, will be faced with sheet steel not lighter than No. 23 gage, weighing 1.12 pound per square foot. These plates will be carefully selected and put on the forms without wrinkles. All form surfaces are cleaned and coated with soaps or mineral oil to prevent adhesion of the concrete.

Small rods supporting the forms are allowed in the structures, if a portion of them nearest the surface, at least 2 inches in length, is taken out. The holes thus left must be filled immediately with cement mortar.

Wooden forms are wetted before any concrete is placed against them, in order to prevent injurious drying of the surface by absorption.

When pipes or other metal work is placed rich concrete or mortar is packed tightly around it, so as to prevent leakage and secure perfect adhesion.

CEMENT DRAIN TILE REINFORCED FOR LARGE SIZES AND UNUSUAL DEPTHS.

By Charles E. Sims, Worthington, Minn.

In the spring of 1912 the writer secured the contract for the 30 to 42-inch cement drain tile for Rock county, Minnesota, Ditch 2. The contract called for 3,700 feet of 42-inch tile, 1,500 feet of 34-inch, 1,300 feet of 32-inch and 2,200 feet of 30-inch. The 42's were to be laid at an average depth of 17 feet 9 inches and a maximum of 22 feet 6 inches; the 34's at a maximum depth of 13 feet 6 inches, the 32's at a maximum of 11 feet 4 inches and the 30's at 9 feet 7 inches.

The earth pressure at the greatest depth of the 42's, figuring the trench 62 inches wide, was estimated at five tons per foot, or fifteen tons on a tile three feet long. The engineer, Mr. L. A. Wilson, Sibley, Iowa, specified a wall thickness of four inches and a system of reinforcing consisting of six wire hoops placed in pairs eight inches apart in the length of the tile, and the hoops of two sizes, such that one set was to be one inch larger diameter than the nominal size of the tile and the other one inch smaller than the outside diameter of the tile.

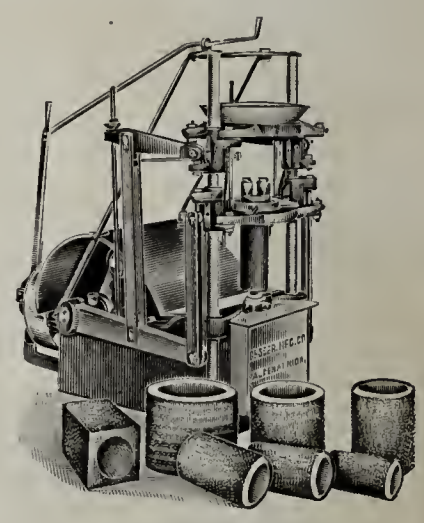
It might have been a saving of metal to have used a deformed steel bar in place of a pair of hoops, since the earth pressures may be assumed to be vertical, and theoretically, therefore, the need for reinforcement exists only at the inside of the tile wall at top and bottom of the tile and at the outside of the tile wall at the sides. To make this clear, let us imagine a tile failing from the load upon it. As the tile fails, cracks open on the inside at top and bottom and on the outside at the sides, hence reinforcing is needed where the cracks can first be seen. It was a question, however, whether the earth pressures would always be vertical; for the banks of a trench of such depth may be expected to cave, in which event the single bar reinforcement might not come at the right place to be effective and the tile be no stronger than it would have been without reinforcement. The wire hoops were therefore considered the better type of reinforcement.

To avoid all risks the reinforcing was placed in the tile six inches center to center instead of eight inches, and all tile for the deepest positions were made of alternately No. 6 and No. 3 wire hoops. Further, the wall thickness was increased from four inches, as specified, to four and one-half inches, and the wires purchased of such diameter as to cover them three-fourths inch from the surface of the concrete.

To make sure that the hoops when dropped into the tile mold would come to the desired position in the concrete, the hoops were wired together in four or five places with No. 16 wire ties, each end wound around the hoop wires and made to project outward five-eighths to three-fourths inch. This process is not expensive, one man being able to tie 250 pairs of hoops in ten hours.

The tile wire made in three-foot lengths, on a National tile machine, by a firm at Boone, Iowa. One part Portland cement to three parts of sand and gravel was used for the concrete, and as much water as possible, with the result that the tile made are practically with watertight walls and it is believed that the bond between the reinforcing and the concrete is all that is necessary for strength and preservation of the metal.

The smaller sizes of tile wire made of wall thickness equal to one-tenth the inside diameter of the tile and reinforced eight-inch center to center with No. 7 wire hoop placed five-eighths inch from the surface of the



The Cement Tile Machine made by the Besser Mfg. Co., 407 13th Street, Alpena, Mich.

concrete, except the thirty-inch, which were made with the walls one-twelfth the diameter of the tile, as they would not be used for six months after manufacture and the thinner wall was deemed sufficient, with good materials, mixed wet and tamped densely.

The 42's have been shipped forty-five miles without breakage, and hauled seven miles frequently when but ten days old, thus demonstrating the quality of material and the effectiveness of the reinforcing in reducing breakage. A thousand feet of the tile are now in place, some under a fill of two-thirds the maximum to tamping the fill at the sides of the tile.

There are other types of reinforcing being used where the concrete is poured into the molds, such as expanded metal, wire cloth, etc., but none are so economical and easily placed without machine delays where the National is used as is the system of hoops. True, the hoops give no longitudinal reinforcement; but it is not necessary to provide against a tile breaking roundways unless under exceptional conditions in drainage work.

Those familiar with the National machine will find the hoops inexpensive to place in the tile if they will station an extra man at the machine to release the friction on the tamper and drop in the hoop while the machine operator raises the tamper to a point above the jacket by means of a rope and pulley attached to it.

For tile of smaller diameters than those mentioned, smaller wire can be used to advantage at an increase in strength or with a saving of concrete worth while where one-twelfth wall can be used instead of one-tenth.

At Sac City, Frazer and Spencer, Iowa, and at Worthington, Minn., tile have been made with the hoop system.

THE REINFORCED CONCRETE CITY HALL OF SAN FRANCISCO, CAL.

The temporary city hall of San Francisco, which is shown in the cut below, represents one of the most notable examples of concrete construction of modern San Francisco. It is the largest concrete constructed building of the town and is finished in concrete even on the exterior.

Since the great fire of 1906 concrete construction has played an important part in the building of San Francisco. To name the buildings constructed of reinforced concrete would be to name practically all of the big buildings of the city.

Many of the big new residences of San Francisco are likewise constructed of concrete.

The fireproof qualities and the monolithic character of reinforced concrete construction were the two properties found to be absolutely essential in the erection of buildings in countries subject to earthquakes, and for this reason has the Pacific Coast become one of the greatest believers in everything made of concrete.

TEMPORARY CITY HALL, SAN FRANCISCO, CAL.

THE CONCRETE HOUSE AND ITS CONSTRUCTION

The Association of American Portland Cement Manufacturers has published under the above title a book of 224 pages prepared especially for architects. The author is Maurice M. Sloan, architect and engineer. This work is not a vague and general discussion of the subject, but a practical working volume, containing every important detail involved in the construction of concrete dwellings. An architect who has never designed a concrete house may, with the aid of this book, proceed to do so without any previous knowledge of the subject. Each chapter has been subjected to the careful scrutiny of concrete experts.

Whether the architect be called upon to build a house of reinforced concrete throughout, or a house with the concrete construction confined to the walls, he will find in the book every essential detail. The chapters on floors, roofs and interior construction will enable him to remodel and make fireproof and sanitary a house of brick or stone. Working drawings, tables and examples relating to every feature of concrete construction as applied to dwellings accompany the text.

In drawing up specifications for the construction of a concrete house, the architect not familiar with the details of concrete construction will find the book invaluable. It covers the entire field of mixing and placing concrete, the casting of beams and girders, floor and roof construction and treatment of surfaces.

The book is bound in cloth and handsomely illustrated with full page pictures of notable concrete houses, a majority of them relating to the text. The illustrations include both exterior and interior views. In the preparation of the book the dominant purpose was to place in the hands of American architects an accurate and comprehensive treatise that would receive recognition as a standard work.

An unusual feature attending the publication of the book is the fact that it is not a commercial proposition, but designed to interest architects in concrete construction and members of the profession will be presented with complimentary copies upon receipt of 14 cents postage. Address Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa.

Inland Portland Cement Plant at Metaline Falls

The industrial development of the greater northwest received marked assistance in the construction of the works of the Inland Portland Cement Company at Metaline Falls, Washington, when the company invested hundreds of thousands of dollars, and established monthly pay rolls running into tens of thousands. Its value to the Inland Empire cannot be over-estimated, as the costs of concrete and fireproof construction have been materially reduced by the local manufacturers of Portland cement.

The construction work on the plant was commenced on the first of June, 1910, and the mill completed on the first of April, 1911. Through a delay in completing the water-power development the plant was not in operation until the first of August, although the mill was entirely completed.

The construction of a plant at Metaline Falls involved the development of a water power, and this phase of the construction will be discussed first.

The power development is of the high head class—approximately a five hundred-foot head, and the completion of the power plant represented any number of engineering questions.

In obtaining available water it was required to dam Sullivan lake on the Kaniksu national forest, and to divert by flume into the lake proper the water of Sullivan creek. Through the dam and diversion of Sullivan creek, Sullivan lake, covering an area four miles long by a mile wide, was raised approximately twenty-five feet, offering an enormous reserve of water.

From the dam at Sullivan lake the water was allowed to pass through the regular channels of Sullivan creek to the reservoir at dam No. 2. At this point a reservoir was made by building dikes and damming a large flat of about fifty acres. From this reservoir the water enters the flume proper.

Regulating gates at the flume control the volume of water admitted and maintain an equal depth at the forebay. The flume is of wooden construction, eight feet wide by six feet deep, and 13,000 feet long, extending from the reservoir to the entry of the main ditch or canal.

The flume is constructed on bed rock, along the side of the mountain, and in places almost a thousand feet above the level of the water of Sullivan creek. From the flume the water passes into the main ditch leading to the forebay, and at that point the volume is controlled by a second series of head gates.

Through the head gates the water enters the tunnel leading to the power house, and, in a distance of fourteen hundred feet, has a vertical head of four hundred and eighty feet. The resultant pressure is two hundred pounds per square inch, as delivered to Pelton impulse water wheels.

View of a kiln room in the cement mill of the Inland Portland Cement Co., Metaline Falls, Wash. The rotary kilns are 140 feet long by 9 feet 6 inches in diameter and were manufactured by the Vulcan Iron Works, Wilkes Barre, Pa.

The power installation consists of two Westinghouse generators, 1,785 k. v. a., direct connected to Pelton water wheels, combined with the required exciters and switchboards. The current is developed at 2,300 volts, and transformed at the mill to a 550-volt base for operating purposes.

From the start of the power plant to the present date the total of time loss is eight minutes, and the results in power costs have been all that could be anticipated.

The raw materials used in the manufacture of the cement are limestone and shale. The limestone quarries are 2,700 feet from the plant proper and consist of a high quality of limestone in an open quarry formation. The usual methods of quarrying are used and the equipment consists of air drills, Marion steam shovels, furnished by the Marion Steam Shovel Company, Marion, Ohio, and cars for delivery to the crushers.

The crushing plant consists of one No. 9 style "K"

Gates breaker, and two No. 5 style "K" Gates breakers.

From the No. 5 crushers the stone is conveyed to the storage bins, and from the storage delivered to the mill by Leschen automatic trams. The trams operate on the gravity system, and generate sixteen horse power in excess of the amount required to return the empty buckets.

The required shale is quarried at a point directly back of the power station, and is conveyed to the raw storage department by a short tram of the Leschen power-operated type.

The raw materials, limestone and shale, are delivered into the raw storage department by the trams, and drawn from the storage by a system of tunnels and Link Belt conveyors, eliminating labor in handling. The two materials pass through the rotary dryers, entirely separate, and, after a thorough drying, are stored in bins above the automatic weighing machines.

The raw material is fed automatically into two seven-foot diameter by sixty-foot Vulcan rotary dryers, and practically all the moisture is removed. From the storage bins above the automatic weighing machine, the raw materials, limestone and shale, are weighed separately and dumped on a conveying belt in the proper proportions.

From the scales the raw material is conveyed to type "B" Jeffrey hammer mills, for the preliminary grinding, and from that point to the stock bins above the 40-inch giant Griffin mills.

The 40-inch Griffin mills complete the raw grinding by reducing the raw material to an impalpable powder of a fineness of 95 to 98 per cent on a 100-mesh sieve. The 40-inch Griffin mills weigh 26,000 pounds each, and are the most modern type of grinding machines used in the cement industry. The machines are driven by 75 horse power vertical motors of the G. E. type, and have a capacity of four tons per hour on raw material of this class.

The Finishing

The screw conveyors carry the powdered raw materials to the stock bins of the rotary kilns, and from that point the material is fed automatically into 9 feet 6 inch by 140 foot rotary kilns. It is at this point that the first real development in cement manufacture occurs, and therefore the process will be followed in detail. In order to thoroughly flux the two materials an intense heat is required, and this is obtained through the burning of a finely powdered coal.

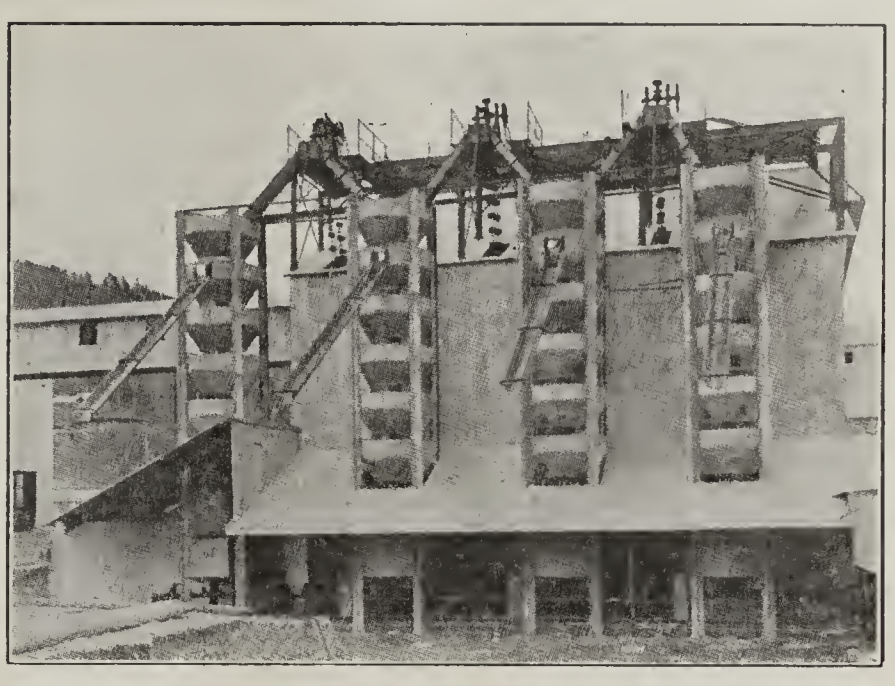
The coal is ground in the coal grinding department on 40-inch Griffin mills, and in the powdered state conveyed to the coal stock bins in front of the rotary kilns. From the coal bins the pulverized coal is conveyed to a blast pipe and blown into the kilns by air pressure. The contact of the powdered coal with the intense heat results in an explosion and a resultant temperature of 2,700 degrees to 3,000 degrees Fahrenheit.

This intense heat calcines and thoroughly fluxes the raw material, which leaves the kilns in the form of a red clinker, turning upon cooling to a sparkling green-black color. The rotary kilns are operated by 50 horse power G. E. variable speed motors, and the coal feed has a variable speed control of a mechanical form.

The rated production of a 140-foot rotary kiln, nine and a half feet in diameter, is 1,000 barrels of clinker in twenty-four hours. The producing capacity of the two kilns at the Metaline Falls works approximates eighteen hundred barrels in the twenty-four-hour period. It is probable a test of short duration would show that twelve hundred barrels per kiln could be produced, although the average is out of the question on the class of raw materials available.

After cooling, the clinker is conveyed by Link Belt conveyors to the automatic scales for weighing and the addition of the required amount of gypsum. The preliminary reduction of the clinker is made on Sturtevant rotary crushers, and from that point it is conveyed to the stock bins in the clinker grinding department.

The finished grinding is done on 40-inch Griffin mills, and a fineness of 96 per cent to 97 per cent on the 100-mesh sieves, 85 per cent on the 200-mesh sieves, is the standard maintained. The mills are operated by 75 horse power vertical motors, and the plant is practically limited to one class of grinding machines. Through this plan the stock of repairs and renewal parts are not excessive, and there are no varied



Vertical Clinker Coolers at Plant of the Inland Portland Cement Co., Metaline Falls, Wash. This cooler was designed by Raymond R. Bear, Chief Engineer of the Lehigh Portland Cement Co., and while comparatively new, has demonstrated its efficiency. It consists essentially of a series of superimposed hoppers, carried on light vertical uprights. The upper edge of each of the hoppers is above the angle of repose of the material fed into the hopper. No material can be lost by overflow. An internal air-cooling arrangement is provided by a vertical pipe. The openings in this pipe at each hopper are protected by a suitable hood. Cold air under light pressure is forced through this pipe. The hot clinker, or other granular material, is fed into the top from a chute, and under normal conditions, forms conical piles in each hopper as it is fed down; it is rapidly and thoroughly cooled.

classes of machines to repair or maintain repair stocks for.

From the clinker grinding department the finished cement is conveyed to stock houses Nos. 1 and 2 for storage until delivery is required. The storage capacity, consisting of two stock houses, is equivalent to 250,000 barrels of finished cement. The company expects to have about 200,000 barrels of cement by the first of March that will be available for shipment.

Through the hourly sampling of the raw materials, and chemical and physical tests, the uniformly high quality of the cement is maintained. The company intends that every barrel shall be uniform, light in color, finely ground, of high tensile strength, and absolutely sound. It guarantees that every barrel will pass the standard specifications of the American Society for testing materials, American Society of Civil Engineers, or those of the various railroads and municipalities. The manufacturers consider quality the paramount question in producing cement.

Accessory Features

In connection with the power development the city of Metaline Falls is furnished with light and power, and the surrounding mines have an available supply of electrical power to the extent of 10,000 horse power.

Incidental to the cement plant proper are the machine shop, consisting of a concrete building and mod-

ern equipment, and the stores department containing all repairs and renewal parts for the plant and power station.

The plant and power development represents an investment of one million four hundred thousand dollars, and a monthly pay roll and purchasing expenditure of $45,000. The company states that with "Inland" on the market the cost of cement has been reduced by fifty cents per barrel, with a resultant saving on construction work in the Inland Empire of an amount equivalent to $300,000.

The plant is essential to the physical development of the greater northwest, and is deserving of the support of the cement purchasers and consumers in the district of its distribution. Industries of this class will make an Inland Empire, and the investors in the plant unquestionably deserve commendation for the confidence displayed in subscribing to an undertaking of this magnitude.

The present officials of the Inland Portland Cement Company are: Harry C. Trexler, president; F. A. Blackwell, vice-president; A. F. Walter, treasurer; Dan R. Brown, secretary; William J. Harry, auditor; Irvin J. Kohler, general superintendent, and Ernest Ashton, chemical engineer.

The sales distribution, purchasing and accounting are conducted through the general offices in the Old National Bank building, Spokane, under the following personnel: Dan R. Brown, secretary and assistant treasurer; John H. Marks, assistant sales manager; William J. Harry, auditor; F. Tilford Brown, purchasing agent; C. A. Smith, sales representative; B. L. Woodmansee, accountant; E. Ashton, chemical engineer.

The works at Metaline Falls are under the direct charge of Irvin J. Kohler, superintendent, and the offices at the mill are controlled by H. R. Hausman.

Through the fact that Col. H. C. Trexler is president of the Lehigh Portland Cement Company, practically every man employed by the "Inland's" organization is a graduate from Lehigh, with years of experience in the manufacture of cement.

SAND-LIME BRICK ASSOCIATION.

Mr. S. O. Goho, president of the Sand-Lime Brick Association, was re-elected at the Toronto meeting held December 3-4, 1912, at King Edward hotel.

Mr. Goho was first elected as president at Washington meeting December 14, 1908, and has shown such force and executive ability, that the members unanimously called upon him to continue the good work, and finally prevailed upon him to accept the office for another year.

When Mr. Goho took hold of the work, the association was confronted with an indebtedness of about $1,500, incurred by the association in defending the new industry, which seemed to be the object of most violent opposition on the part of the building trade and the manufacturers of clay products.

The treasurer's report at the 1912 meeting showed all liabilities settled and a balance in treasury of $450.

Of even greater importance was the showing made of the work accomplished by the association, which had placed it in such good standing that for the past three years the United States Bureau of Standards has sent a representative to our meetings, and have made an exhaustive examination and tests of our product, proving and establishing its excellence, writes W. E. Plummer, Jr., Buffalo, N. Y., secretary of the Sand-Lime Brick Association.

This work of our association under the able management and direction of the president, Mr. Goho, has made the manufacture and sale of Sand-Lime Brick a growing and profitable industry, both for the manufacturer and consumer, and the use of sand-lime brick is so rapidly increasing, that the permanency of the industry is already established.

Mr. Goho is a man of genial presence and wins the kindly feeling of all with whom he comes in contact. He is the sales representative of the Hummelstown Brownstone Company, of Waltonville, Pa., whose immense quarries have furnished a beautiful

S. O. GOHO, WALTONVILLE, PA.

brown stone for innumerable churches and public buildings all over the country. The brick made by this company is a side line only for them and are made from the ground sand-stone from their quarries, and it can safely be said that there are none better, and in fact, their product being of such excellent quality, and their process so entirely individual in its design and method that the association gladly accepted an invitation to hold the 1913 meeting at Harrisburg, thus enabling the members to visit the Waltonville plant.

Mr. Goho couples with his busines acumen, a lively literary taste, and in fact has edited and published several text books now in use in the school work of his state.

Our object in introducing our officers to the public is that anyone desiring information that may be depended upon may call upon them to receive assistance.

The Action of Alkali on Cement Pipes

By Will L. Brown *

It may be of interest to some of our water companies and individuals and also to some of our contractors in this land of irrigation, to know some of the effects of alkaline water on concrete pipe. A knowledge of when not to use any material is far more just to that material than to condemn it entirely because it has failed in some instance when it should never have been used at all.

My attention was called some time since to a cement pipe line in the upper San Bernardino Valley adjoining this city that had become "rotten" and failed. In company with two other engineers, I made an examination of the line in question and was much surprised at what we found.

The pipe was about 1,000 feet long, 10 inches inside diameter, and made and laid under contract as a drain from a pump-pit situated in a low, wet tract of land. The ground water in this tract was from 3 feet to 5 feet below the surface in summer and in winter water stands in all depressions. The soil itself is a close-grained fine sand, and clay, quite heavily charged with those mineral salts commonly termed "alkali."

The "alkali" from this particular locality has never been analyzed so far as I have been able to learn, but is probably of the same composition as other white alkalies of southern California, viz., the sulphates of calcium and magnesium, together with smaller quantities of sodium chloride, nitrate, carbonate and generally some bicarbonate. Altogether this makes a very caustic, active solution, especially that portion at or near the surface, where for many seasons the waters working up from below have brought the salts with them, and then evaporating during the succeeding dry summers have left excessive quantities of the solids, as a white incrustation of efflorescence.

The pipe was a good average cement pipe, made under a 1:4 specification, and although no especial pains were taken either in mixing the aggregate or in the tamping and curing, it would pass inspection without any serious objection. It was washed inside with a neat cement wash to lessen its porosity. The line was laid from 4 feet to 8 feet deep, with considerable difficulty, because of water and caving trench. Some of the joints were made with plaster of paris, but the jointing was seldom water tight.

The third year after laying, depressions appeared over the line and in the fourth year several large pits formed—some of them 8 feet across and of various lengths. In several instances when the surface dropped, tunnels were observed, extending along the line. This sinking was caused by ground water washing the earth away wherever a pipe failed. In the fifth year the line was entirely useless, and a new line of vitrified clay pipe was constructed.

An examination of many fragments of pipe taken from the line showed the cement to have almost entirely disappeared from the outer portions of the pipe wall. The sand could be readily crumbled with the fingers, it often being nothing more than a sandy mud. What cement-like material still remained had no life or strength at all.

The inner part of the pipe wall where the cement wash had penetrated about 3/8 inch was less affected and retained its form, though possessing very little strength. These fragments when allowed to dry in air crumbled and often fell apart.

. . . . Reprint from "Southwest Contractor and Manufacturer."

*Consulting Engineer, San Bernardino (Calif.) Water Co.

This disintegration of cement in the presence of alkaline solutions has been very carefully investigated by the chemical department of the Montana Agricultural Experiment station and also by the Colorado Agricultural College. The results of these independent investigations show a remarkably close agreement, and with a number of similar failures that have come under the writer's observation, indicate that the use of cement pipe in many locations is very likely to be a misuse of this very economical material.

The chemical reactions taking place when the alkaline ground waters come in contact with the cement, are very complex. The liberation of calcium hydroxide during the process of setting, and later hardening of the cement means that a compound is formed which even distilled water will dissolve and carry away. When we have this reaction and solution taking place in the presence of strong alkaline solutions and under several pounds' pressure, the effect is much accelerated. M. W. P. Headden, chemist of the Montana experiment Station, mentions a sample of cement tiling reduced to a putty-like mass mixed with sand after being laid only eight or nine months.

These reactions are continuous; soluble compounds are formed and carried away by the percolating waters, thus constantly exposing new surfaces, and it is only a question of time when the pipe falls. This effect is readily seen in concrete-lined ditches carrying a constant stream and even in irrigation pipe with only an intermittent flow.

All the ground waters of the Southwestern United States carry a considerable content of these alkali compounds, especially magnesium and calcium sulphates. All sulphates are active in their action on cement, and magnesium sulphate is the most active of all. The water coming from our granite mountains contains this salt in very large proportion. Its action on cement can be clearly observed in every concrete-lined conduit, even the stones laid in cement mortar and lining many ditches, can often be lifted out or will drop, after two or three years of contact with the running stream.

Most interesting and complete discussions of this subject are given in Bulletin No. 132 of the Colorado Agricultural College, and in Bulletins 69 and 81 of the Montana Agricultural Experiment Station.

Quoting from Circular No. 8, issued by the Montana Experiment Station: "We recognize this as a cement age, but this fact does not warrant its use in important structures by people who have not given it some special study. With our present knowledge we could not advise the use of cement pipes for drains or sewers where they are to be laid in alkaline ground. When prepared by the ordinary methods we believe that concrete should not be used where solutions of alkali will come in contact with it. In such pipes or drains the pressure of the ground water tends to force the alkali through the concrete and hasten the disintegrating action."

Here in Southern California where hundreds of thousands of dollars in crop values depend on irrigation, the users of this kind of pipe should investigate the matter for each location or system, as the failure of a pipe line at a critical moment in our dry summer might mean the loss of many times the cost of a more durable material.

In referring to the above article by Mr. Brown, Mr. Llewellyn T. Bachman, chemist, Santa Cruz Portland Cement Company, Davenport, Calif., writes as follows to "Concrete Cement Age:"

That alkali affects concrete is not disputed by engineers who have examined the subject, but a great difference of opinion exists regarding the extent of the action. Irrigation engineers who have found the action of alkali to have been particularly severe on the Sun River project in Montana, near Great Falls, and also on the Shoshome project in northern Wyoming, have investigated the subject carefully and continue to use concrete, although of a denser quality than before the alkali troubles were diagnosed. In Iowa, where the subject is receiving very careful attention, the opinion is growing that a hard, dense surface resists alkaline action on concrete drain tile far more than ordinary concrete. The subject is a very complex one and requires years of investigation to prove anything decidedly conclusive, but it is known that waters containing magnesia must be avoided in making cement mortars for concrete pipe, in that a hydrate of lime is formed by the action of the water on the cement and in turn precipitates the magnesia from the water used, all of which forms a part of the mortar and the hydraulic value is disturbed by the parting plane.

The same may be true in the use of waters containing sulphates which readily form double salts. That is, a simple sulphate will stubstitute a portion of its magnesia of soda for lime, iron or alumina, thus removing some constituent of the cement and substituting in its place a soluble alkali. The effect may be similar when cement concrete becomes a depository of sulphates from infiltrating waters which are evaporated in any way from the concrete so as to leave the salts behind. The percentage of sulphate would increase until it would finally destroy the concrete.

To avoid this result in soils that contain such waters, one way is to provide a natural drainage which will cut off the water from permeating the concrete; and another to prepare the concrete so as to render it impervious to water. We know of cisterns which serve as reservoirs for alkali waters to have resisted the alkali action for 10 years and today are apparently in as good a condition as ever.

From all we know it would appear that concretes made under similar specifications are not adapted to all classes of work. It is known that the heavy foundation specifications would not meet the requirements of a sidewalk surface; and therefore one may learn that the imperviousness in concrete will be the solution for that class of concrete work used as drain tiles in alkali districts.

BUILDING CONTRACTS

By W. J. Stanton

Where the compensation is payable in installments as the work progresses, the final payment becoming due upon the completion of the work, and certificates of approval are required as a condition incident to the right to demand payment, the certificate given during the progress of the work is not regarded as conclusive that the work therein certified to was properly performed, and the architect may properly refuse a final certificate on the ground that the work has not been properly done. The architect's certificate of approval is not conclusive against the builder as regards latent defects in the performance of the work which could not have been discovered by the architect.

If the work is approved by the architect and his certificate is issued in performance of a fraudulent agreement or understanding between him and the contractor, the certificate is not conclusive as against the builder, and the latter may, after establishing fraud, show that the work was not properly performed. As regards latent defects, a case before the Missouri Court of Appeals is illustrative. In this case a building contract provided that the house should be built according to certain drawings and specifications, the work "to be done to the satisfaction of the architect," who should give a certificate to that effect. The contractor failed to use the kind of varnish for wood finish required by the contract, but substituted therefor a cheaper and inferior varnish, and the evidence showed that the architect was absent while the varnishing was being done and that the use of the inferior varnish could not be detected when it was put on, but would only be developed by time. It was held that the certificate of acceptance of the architect was not conclusive as to the latent defects arising from the use of inferior varnish.

The architect's or engineer's certificate may also be attacked, and a failure to perform shown when the certificate is issued under a mistake, and if the architect is grossly negligent in certifying the execution of the work, his certificate is not conclusive against the builder.

Where the architect or engineer, subject to whose approval the work is to be performed and from whom a certificate is to be procured, refuses to act, this will excuse the failure of the contractor to secure his approval and certificates. So where the builder has by his own act rendered it impossible for the contractor to secure the approval and certificate of the architect or engineer, the failure to do so will be excused; as where, prior to the completion of the work, the builder discharged the architect subject to whose approval the work was to have been performed, or where the builder fails to employ an architect or engineer to supervise or approve the work, or where the builder wrongfully compels the contractor to abandon the work before completion.

It has been held that the procurement of approval and certificate will not be required where its procurement is rendered impossible, by accidental causes and without the fault of the contractor, as where, after furnishing materials and labor for a part of a building, the building is destroyed by fire before the required approval and certificate can be secured. So the death of the architect during the progress of the work will dispense with the procurement of his certificate of approval; but where after his death, another was, by agreement between the builder and contractor, substituted in his stead, the certificate of the latter must be procured.

The provision requiring the architect's or engineer's approval and certificate of performance is for the benefit of the builder, and he may waive a compliance therewith by the contractor. Such waiver may be implied as well as expressed, and when there has been a complete or substantial performance, the purpose of the certificate as evidence of that fact being otherwise supplied, slight evidence of waiver is sometimes sufficient. If the builder, where demand is made for payment of the compensation, after the contract has been performed, bases his refusal upon other grounds than the failure of the contractor to procure the architect's or engineer's certificate of approval, and does not demand such certificate, he will be deemed to have waived the production of such certificate. So where in defense to an action for the contract price the builder merely pleads that the work was not properly performed, and fails to plead the failure to procure the

certificate of approval, he will be deemed to have waived its production. A promise by the builder after the work has been performed to pay therefor without requiring the certificate will be deemed a waiver of its production.

The mere fact that the builder takes possession of a building or other structure erected upon his land will not necessarily constitute a waiver of a provision in the contract for its construction requiring as a condition precedent to the payment of compensation the architect's certificate of approval, but it is otherwise when the possession is taken and the building is accepted as under a completed contract. Where the compensation is to be paid in installments during the progress of the work upon certificate of the architect, the payment of installments during the progress of the work without requiring the production of certificates will not of itself be construed as a waiver of the requirement for the production of the certificate of final completion. It has been held, however, that a part payment of the final installment, which was payable only on completion of the work and the production of the architect's or engineer's certificate of approval, will constitute a waiver of the production of such certificate.

Where the architects certificate of approval is fraudulently withheld or refused, through collusion with the builder, its production by the contractor will be refused, as where, though the work was properly done, the certificate was withheld by the architect on account of an order from the builder to do so, and not because the work was not properly performed. Of course, the withholding of the certificate of approval cannot be deemed wrongful so as to excuse its production by the contractor unless there has been a substantial performance of the contract, and so long as any portion of the work is incomplete and so situated that it may be fully completed the withholding is not wrongful.

FACTOR OF SAFETY IN REINFORCED CONCRETE.

By Robert G. Clark, A. M. Inst. C. E.

The factor of safety in a reinforced concrete structure has generally been devoted by the ratio of the maximum working stress in the steel to the ultimate strength of the steel. For example, assuming that the working stress is 16,000 pounds per square inch, and the ultimate strength is 64,000 pounds per square inch, the factor of safety would be 4 by this theory.

Others, again, take the view that if the steel is stressed beyond the elastic limit the structure has to all intents and purposes failed; and, taking this line of reasoning, the factor of safety is expressed by the ratio of maximum working stress to the elastic limit of the steel. Assuming the working stress at 16,000 pounds per square inch and the elastic limit at 45,000 pounds per square inch, we then have the factor of safety reduced to about 2.75. This, however, is purely a theoretical calculation which deals with steel only; but in any scientifically designed reinforced work, we know that the concrete shares with the steel an equal responsibility concerning the stability of the structure, so that, before the factor of safety can be accurately determined, it is essential to see that the concrete also has an ample margin of safety. This point is too frequently overlooked.

The designer in the matter of the quality of the steel can safeguard himself by specifying that the Standard Specification must be adhered to, but unfortunately no such standard is available for the concrete. It is true that, so far as the cement is concerned, we have the assistance of the Standard Specification as regards quality; but in the matter of the quantity of cement, the greatest latitude is allowed when we have mixtures varying from 1 : 4 to 1 : 9 parts of cement to aggregate.

Dealing with the aggregate used for the concrete, this is more or less controlled by the materials available in any given district; and here, again, to make matters worse, much difference of opinion exists as to suitable concrete materials. Very often the selection is left to the contractor, whose natural aim is to get something cheap in order to outstrip his competitors; and as the designer is generally many miles away, he may not know of this arrangement, and the prejudicial effect it may have upon the factors of safety provided by his elaborate calculations.

In the past, it cannot be denied that the concrete has been more or less overshadowed by the advocates of particular kinds of reinforcing steel; but the concrete in reality needs more attention than the steel, not only because of the reasons stated above, but also for the reason that the lifetime of the structure depends upon the efficient protection of the steel from corrosion. Therefore, as we assume in assessing the factor of safety of the steel that it will not deteriorate, every care must be taken to protect it; and this can be done only by having the concrete composed of the best materials available, carefully graded, and mixed with a generous quantity of the best cement.

It is by no means uncommon for competitors to state their calculated factor of safety; and it is interesting to note that for precisely the same work the factors of safety given by various firms vary from 4 to 9. How the latter figure is arrived at is frequently a mystery, especially in cases where the firm submitting the lowest tender quote the highest safety factor.

It is obvious that something should be done to standardize the method of calculating the factor of safety, and that any method adopted should include due consideration of the strength of the concrete mixtures. It is altogether unfair to fix a limit of working stress on the concrete, unless inquiry is also made into its constituent parts, as the limit may be much too low for some mixtures or too high for others.

In conclusion, it must be pointed out that the actual factor of safety is much above the calculated value if the best materials are used; but it should be remembered that the calculated factor of safety is used only for the purpose of comparison. With a good concrete, and steel efficiently protected, the factor of safety increases as time progresses, owing to the fact that the concrete increases in strength with age, and in this respects affords a striking contrast with structural steel, timber, or brickwork which are at their best when new.—Ferro-Concrete.

WORK OF A MUNICIPAL QUARRY

The report of the Board of Public Welfare of Kansas City, Mo., gives the results of the operation of the municipal quarry. There are five points at which the quarrying is done, and both foundation and crushed stone are produced. During the past year employment was given to 1,334 men. The total receipts of the quarry were $8,445.47, and the disbursements in operation $8,391.16, leaving a balance of $54.31.

CEMENT DUST

The Tidewater Portland Cement Company, at Union Bridge, Maryland has been indicted in the court, charged with unlawfully discharging into the air dust which is wafted over the city, doing damage to buildings and other property.

CONTRACTING ON A PERCENTAGE BASIS MANY SIDES OF AN IMPORTANT QUESTION —THIS PLAN MORE FREQUENT IN THE WEST

(From the Western Canada Contractor.)

The percentage plan of handling contracts has been adopted recently by a number of prominent contracting firms in Western Canada. This plan is one which in many ways suits some departments of the business much better than does the older "lump sum" method. It is a recognized fact that one of the greatest difficulties and drawbacks of the contracting business is the difficulty of reaching a satisfactory basis of relationship between the contractor and the owner. Under the ordinary method of contracting, the interests of the two parties, it will be readily seen, are often diametrically opposed.

Once the contractor has secured a contract, it is decidedly to his interests to rush the job to completion as quickly and as cheaply as possible. Quickness is quite essential as it tends to an early completion, an early settlement, the opportunity to use his gear and equipment in connection with other work and the closing up and getting from off his hands the necessity of supervision of the work. But cheapness is still more essential than is despatch in the carrying out of the work. It is here that the interests of the contractor and his employer are opposed. Every dollar that the contractor spends comes directly out of his own pocket. The temptation is always present to curtail expenditures with the probability that the owner's interests will suffer if this is done. Philanthropy and the contracting business are very far apart. The principle that the better the class of work and the materials used the lower the contractor's profits is not a principle that may be said to be conducive to the best results and the highest quality of work.

It is conditions such as are described above which make it possible for the wider adoption of a different system of handling contracts of a general nature. These conditions are responsible for the use of the percentage system, which is a system that lacks many of the drawbacks of the usual method of handling contracts.

The Usual Percentage Method

When the subject of contracting on a percentage basis is alluded to it is usually associated with some such rate as ten per cent. This rate might be said, however, to be higher than the average; many large and important jobs are being carried out in the West at the present time at rates ranging from six per cent to ten per cent, the latter rate being the highest paid and the average being perhaps eight per cent. The fixing of the rate depends entirely, of course, upon conditions under which the contract is to be carried out. It is in this connection that the one opportunity is provided for competition among the contractors, the lowest rate bidden having, of course, the first chance at securing the contract. It is in the bidding that the contractor has an opportunity to make a loss by bidding too low a rate, although the consequences are not apt to be nearly so serious as in the case of bidding on the job by the lump sum plan. He must figure upon all the conditions specified, what he will be obliged to supply in the way of gear and equipment, how great the wear and tear will be upon that gear and other matters of a similar nature, all in addition to the regular and usual matters which come up for consideration in connection with the bidding on a contract, many circumstances have a bearing upon the making of this rate. It is possible that the owner may provide a hoist or some of the other important parts of the oufit required. The question of the providing of the lumber for the forms in a concrete building is always an element—these and similar circumstances have a bearing in the deciding of the rate. The lower the rate, the less the contractor can afford to supply. When the rate is as high as ten per cent, it is safe to assume that the contractor is supplying everything in the way of gear and equipment as well as the materials and supplies necessary to the actual carrying on of the work. In cases in which the rate goes as low as five per cent, the contractor will probably supply very little in the way of plant and might be said to be merely acting as a building superintendent with the additional responsibility for the successful outcome of the work.

The rate is figured on the total cost, an estimate of which is prepared by the architect. If the total cost exceeds this estimate, the contractor is allowed his percentage at the same rate specified in the original agreement. In case he is able to complete the job at a less figure than that specified by the architect, he is a material gainer, as he is allowed a good percentage on the amount saved. The rate of the allowance on the amount thus saved ranges from twenty-five per cent to fifty per cent. The greater the rate provided to cover such a saving, the greater the incentive to the contractor to save and while doing so he is saving for both himself and the owner.

It is this principle of dividing the savings which is one of the most attractive features to the man who has the true principles of business in mind. It will readily be seen that there is every incentive for the owner and the contractor to work together, how the contractor, while working for himself, is helping the interests of the owner and how both benefit by his efforts. The better the building and the higher the class of workmanship, the greater the returns to the contractor. Both parties gain by the extra expenditure, a more equable arrangement than under the older and more widely used system by which the better the building the less the profit of the contractor.

Advantages to Both Sides

The percentage system is a safer one for the contractor than is the lump sum system. There is little or none of the risk of making a mistake and taking a job at too low a figure. He has none of the responsibility for the total cost of the work, which, under the ordinary plan, is the greatest element of risk in connection with the business. His entire risk consists in the possibility that he may figure his rate too low—a risk that is a small one in comparison with the danger in other plans of taking jobs. Should he happen to make this mistake his loss will not be nearly so serious a matter than if the entire responsibility were his.

The percentage plan is one of many advantages to the owner. He has a greater knowledge of operations and a much more direct control of the work. He is able to specify any change or extra outlay without the necessity of dickering with the contractor. He may also effect a considerable saving if he so desires —by paying the bills in such a manner that he will save his cash discounts. He has a greater knowledge of both the quality and costs of the materials used. At the same time he has the advantage of having the work carried out and supervised by a contractor of experience who can use his knowledge and ability as well as his trade connection to further operations knowing that the better the quality of his work, the greater will be his financial return.

Compared With Other Plans

Many comparisons have been made and much dis-

cussion has taken place regarding the subject of the best form of contract. The solving of this problem is a difficult one. Each plan has adherents and vigorous ones. To the contractor who feels that his executive ability is such that he will speculate on it and that he must have such an opportunity to realize on it, the ordinary method presents the greatest opportunity. It is often the case that contractor—particularly in Western Canada—will spend thousands of dollars in plant and equipment in order that they will be able to carry on their work at the lowest possible cost and so that they will then be in a position to carry out a job at a lower figure than is generally recognized as the average cost. To those who thus wish to match their organization against the conditions and circumstances in connection with a contract, the lump sum will be the favored plan. To the firm or individual who wishes to follow a more conservative policy and to eliminate as far as possible any chance of loss the percentage plan will appeal most strongly. The latter plan has features which recommend it in the case of a job consisting of alterations or repairs—in connection with jobs of this nature there are so many opportunities for mistakes in figuring a bid as well as for disputes and differences of opinion. For the contractor who is starting business in a new country where he may be more or less unfamiliar with conditions, the percentage plan will have much to recommend it.

The "cost-plus-a-fixed-sum" method of awarding contracts has many adherents among contractors. It would seem as if this plan would place the contractor simply on the footing of one who works for a fee. It is scarcely in human nature for the average man to take the same interest in his work as he would under one of the other plans mentioned in this article. When chance and risk and the prospect of a greater or less return is eliminated, it is safe to say that the average contractor will take a less active interest in the work. True, the contractor of integrity will give conscientious service under any circumstances but he lacks incentive; he is not an active partner in the work but practically a wage-earner.

Not Suitable for Small Jobs

The percentage plan has its limitations. One of these is its unsuitability for small jobs. There are many reasons for this, all of them important. The principal reason is that the total amount of the small contract is not large enough to bring the amount of the contractor's commission to a total that would prove any inducement. In addition to this—as every contractor knows the small job, such as building a residence, must be watched quite as closely and diligently as the large job. It is easily apparent that the percentage plan does not work out in connection with small jobs and must necessarily be confined to the larger ones if the contractor would receive returns for his work.

CONCRETE SEWERS

P. O. Sheridan & Co., Houghton, Mich., has just been awarded the contract by the city of Iron Mountain, Mich., for the construction of reinforced concrete sewers. The work includes 1,650 feet of 48-inch Jackson pipe, reinforced concrete sewer, 616 feet 6 inch laterals, 366 feet of 8-inch, 1,650 feet of 12-inch drain pipe with necessary manholes and catchbasins. The contract price is $10,725.

A GOOD, CHEAP CONCRETE FENCE

A concrete fence which should prove of interest to our readers was recently designed by R. V. Moss, city surveyor of New York City, for the Glen Ridge tennis courts.

A strong and durable fence was desired, of neat appearance, one that could be quickly erected and at low cost.

At 12-foot 1-inch centers 3-inch I-beams 12 feet 6 inches in length were sunk in the ground to a depth of 2 feet 6 inches, leaving ten feet of post above the surface.

The flanges of these beams were wrapped with expanded metal lath to a height of six feet above grade to carry cement plaster.

A 2-inch by 3-inch spruce bottom rail was placed between the posts along the ground and a top rail of the same size at a height of six feet with Rib-Trus Reinforcing Plates, manufactured by the Berger Manufacturing Company, Canton, Ohio, extended to cover the space between.

The concrete was then applied on the reinforcing plates to a thickness of three inches.

Above the reinforced concrete portion of the fence wire netting is fastened to the height of four feet, making the entire height of the fence ten feet, six feet of which is concrete and the remainder wire.

The cost of this type of fence is extremely low, especially for the concrete portion of it, which, in this case, is increased by the fact that the I-beam posts extend four feet above the concrete to carry the netting.

The concrete portion alone cost about 25 or 30 cents per square foot, including the contractor's profit, which made the cost of the six-foot fence from $1.50 to $1.80 per lineal foot.

The average fence costs from $2 to $2.50 per foot—is neither as easily nor as quickly erected and seldom as strong and durable.

Mr. Moss has certainly offered us an excellent design in this fence and one we would unhesitatingly recommend for this and similar purposes.

LUTEN PATENTS

Several of the concrete bridge patents of Daniel B. Luten were sustained in a suit brought by Mr. Luten against John W. Barlow, January 30, 1913, in the United States District Court of the Dictrict of Indiana, the decree being handed down April 5. The patents involved covered improvements in centering for and method of constructing arches; improvement in arch structures; improvement of system of reinforcement for concrete and similar structures, and improvement in bridges of concrete and other structures.

Cement Blocks For Factory Construction

Cement blocks are coming to be very widely used in factory and warehouse wall construction. This has followed the development of several systems of block manufacture which give blocks of good appearance, excellent weathering qualities and shapes sufficiently varied to form pilasters, sills and copings.

The Universal Portland Cement Company's buildings at Buffington, Ind., and at South Chicago, Illinois, show several distinct types of concrete construction, the latest being of reinforced concrete frame, cement block curtain walls and cement tile roofs. The new work comprises a sack house at South Chicago and nine buildings at Buffington, for Plant No. 6, and ranging from 90x300 feet down. They have involved the use of nearly 90,000 blocks.

The blocks were made on an Ideal machine, model E, and were of two sizes, 6x8x24 inches and 8x10x24 inches. Special blocks fitting around the columns at corners, windows and doors were made by blocking out parts of the standard size mold. The walls are 8 inches in thickness, using the smaller sized blocks, the larger sizes being used to form pilasters around the concrete and steel columns and to form the eave and water table courses.

In making up pilasters around columns of reinforced concrete there was no difficulty as the surfaces were straight and smooth, but in surrounding steel columns is was necessary to allow clearance on all sides and fill in the space with concrete after placing the blocks. It was also necessary to brace the blocks from the outside to prevent displacement from pressure of the freshly poured concrete.

The blocks were made with a rough face produced by a mixture of one part cement to 2½ parts of limestone screenings, passing a four-mesh screen but reblocks were stored under cover for at least two days and kept damp during this period. They were then piled in the open air and watered twice a day for a week.

The blocks were made about one month in advance of being placed. The block walls present a very clean, attractive appearance. The joints are pointed on the outside surface only, leaving the rough inner surface for plastering.

Another example of good block construction is the Gas Engine Electric Station at the Illinois Steel Company's plant at Joliet, Ill. The building has concrete foundations, a steel frame, concrete slab floors, a roof covering of cement tile and curtain and partition walls of concrete blocks. It is 114 feet wide by 206 feet long and is excellently lighted, Lupton metal sash being set directly into the block walls without frames.

The blocks are unfaced and made by the method of the American Hydraulic Stone Company System of Chicago. A 1:1:4 mixture of cement, sand and limestone screenings was used with an excess of water and the blocks were made under heavy pressure. They were cured in steam for 36 hours, and afterward stored until needed.

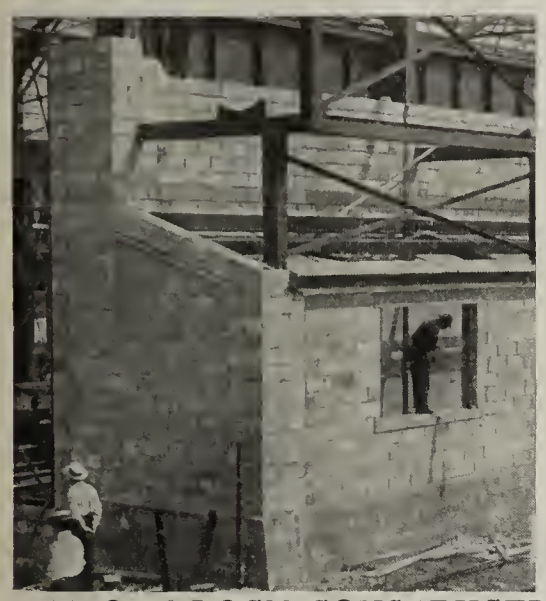
CEMENT BLOCKS FOR FACTORY CONSTRUCTION.

The blocks were laid up in Portland cement mortar, the average number of blocks laid per man per day being 250 of the 9x24-inch face size, each of which displaced 17 common brick. The best day's record in the manufacture of blocks was 750 and four men were required for the several operations.

The header bond principle of this block construction produces a very stiff unit masonry wall. It has both a horizontal and a vertical air space, giving excellent insulation between inner and outer walls. It is readily plastered without furring or lathing and the blocks are laid up into a wall with considerable dispatch.

The work of the Illinois Steel Company was not such as to require a special aggregate for the block faces but the additional cost is so small with this system that the more attractive block faces would generally be used. The block machine is so designed as to pertained on a twelve-mesh screen, and mixing stiff. The backing was of plain concrete. The capacity of one machine was about 200 blocks per ten hours. The

mit casting face upward yet curing with the face in contact with the pallet. Plain concrete is placed first in the molds, struck off and the special facing aggregate is placed upon it. The sheet iron pallet remains in contact with the block face until curing is complete. The machine may be set to make blocks for thick or thin walls with the same bonding principle and the same air space.



DETAIL OF BLOCK CONSTRUCTION.

The use of concrete blocks must become very wide when the architect or designer is assured of an uniform non-absorbent block of good weathering qualities and a considerable range of texture and color. Increasing standards and improved methods, especially along the lines of more perfect curing, are influencing architects and builders to specify concrete blocks and we may expect them to take a commanding position among the building materials of the better class within a very short period.

Concrete blocks are the logical material for factory and warehouse walls as well as more pretentious buildings where economy is not such a large factor. They may be made with as great care as required, and with special facing mixtures of crushed granite or marble, furnish a very high grade product. Yet they are made in the same machine and backed with the same concrete as used for the common blocks and are only a little higher in cost.

A more general understanding is needed today among block makers of the methods for more thorough curing, for the use of high grade facing materials and for the making of blocks of variety in color, texture and shape. Block manufacturers must be thoroughly conversant with the new methods and when this is generally true the use of blocks will increase greatly.

CONCRETE FENCE POSTS, C. & N. W. RY.

Four or five years ago the Chicago & Northwestern Ry. found it difficult to maintain a line of fence along the Boyer river, between Denison and Missouri Valley, Ia. Believing that the solution lay through the use of concrete fence posts, a plant was built at Dunlap. It was equipped with 265 7-foot line post molds, twenty-five 8-foot end post molds and three men were put to work at hourly wages of 16½ and 17½ cents. Reinforcing consisting of ⅛ inch x ⅝ inch x 6 foot steel strap was used. The mixture corresponded to a 1:2:4 concrete. Five thousand posts were made at a cost of 18.3 cents apiece for line posts and 53 cents for end and brace posts. The Indiana Concrete Mold Company, 25 W. Canal street, Peru, Ind., will be glad to send any of our readers their latest catalog and prices on molds for making concrete fence posts.

One very important feature in sidewalk construc-

SIDEWALK CONSTRUCTION

I believe that fully 50 per cent of all our cement work is either slighted or inefficiently done. This applies even to sidewalk construction, which is considered by some contractors to be so simple as to be beneath their attention. This very fact has perhaps helped to prevent it from getting the amount of care which it deserves.

I have often been accused of using too much cement in my sidewalk work. It has been pointed out to me time and again that I could use less cement, do apparently as good work, and make more money for myself. However, I have failed to see but little, if any, good work done by the class of contractors who advocate this method. I am convinced that if every contractor who is now or has been in the business had always used the best of materials, and in proper proportions to give the best results, the demand for cement today would be far in excess of even the present remarkable figure.

The time is not far in the future, I believe, when the standards of concrete work will be raised very appreciably, forcing the dishonest or incompetent contractor either to come up to the demands or go out of business, writes Mr. H. A. Allen, Streator, Ill. in "Cement Era."

It is impossible to do work that will last very many years if your sand and gravel are heavily impregnated with vegetable matter, as deterioration soon takes place; and in addition to this, it is almost impossible when these conditions exist to get a satisfactory color.

One of the important features in sidewalk construction is the securing of proper grades; and if the contractor, or his foreman, is not a good mechanic, you get a botch job—and a dissatisfied customer. I exercise great care in lines and grades and thus secure a very pleasing effect.

If all sidewalk work were done according to right principles, the architects and engineers would not need to specify expansion joints to prevent the water from "humping up" the walk. If a proper amount of cement is used in the concrete, there will be enough contraction after setting to overcome all expansion, provided a joint is made in the concrete not to exceed every 6 feet.

The writer has been in the business of cement construction over twenty years, and if my experience in this particular point of sidewalk construction is of any value, then the above statement is correct, provided a good grade of materials is used.

My experience leads me to believe, also, that semi-wet concrete, well tamped, is much the best for sidewalk work, as it affords a more perfect shrinkage. Concrete loosely tamped provides for trouble ahead.

Until a few years ago I did my sidewalk work with wood forms. Now steel forms have entirely supplanted these in my own work, and to a great extent in the work of other sidewalk builders. I was the first contractor in this city to use the Heltzel steel forms, manufactured by the W. B. Jones Boiler Works Company of this city; now ten of our contractors are using the Heltzel system, and I feel safe in saying that neither they nor any others who have adopted these forms have ever regretted it. With this system I can start mixing concrete at the same time I began setting the forms. This I could not do with 2x4's and stakes. One feature greatly in favor of the steel system is the division plates, which make a perfect seam and also allow plenty of room for expansion provided they are properly spaced.

Blocks should not contain over 30 square feet.

tion is overlooked by a large number of contractors, and that is the spreading of the top finish thoroughly on the concrete so as to insure a perfect bond. Do not be afraid to use plenty of elbow grease. Muddy gravel should not be used at all, as the contractor who does this runs the risk of having his top finish separate from the body of the walk. I use rock grit for the finish, as I think it is better and gives a more lasting color.

I have a set of specifications that I submit herewith. They have been adopted in several of our cities and villages, and any contractor who follows said specifications will not go very wrong.

Specifications for Cement Walks

Grades:—Grade lines shall be established and grade stakes set by proper authority without cost to the contractor.

Excavation and Foundation:—Contractor shall excavate to a depth of not less than 7 inches below grade line, and any loose or spongy material appearing shall be removed and a more substantial filling substituted and well tamped. A bed of cinders, gravel or broken stone shall be placed in this trench and made to come within not less than 4 inches of grade after being well wet and tamped.

Forms:—Upon each side of this foundation, forms made of sound lumber not less than 2x4 inches (or steel forms of the Heltzel system) shall be placed and well staked, that walks may conform to the line when finished.

Cement:—The cement used in the concrete and wearing surface for any walk or work shall be the same brand throughout, and shall be one of the best brands of Portland.

Concrete:—The concrete shall be composed of one part cement, four parts best crushed lime rock, granite, or good clean gravel, and three parts clean torpedo sand. This shall be well mixed dry on a platform by shoveling three times, and after water is applied shoveled twice more, and without being allowed to stand more than one hour after wet. It shall be placed on the foundation within the forms so that after being there thoroughly rammed with a tamper weighing not less than twelve pounds it shall come to within five-eighths of an inch of grade line.

Wearing Surface:—As soon as possible after concrete is tamped into place a top finish shall be spread thereon, five-eighths of an inch in thickness, composed of one part cement to one and one-half parts rock grit or best torpedo sand, free from loam, and shall be well floated and troweled to a neat finish.

Walks Blocked:—Before being tamped into place, the concrete shall be blocked by a distance block of sound lumber 2x4 in size, placed at right angles with the forms, each block containing not over 30 square feet, and directly over this seam in concrete a seam shall be cut in the wearing surface with a tool made for that purpose. Not at any time shall the seams be cut in the concrete with an ax or other tools made for that purpose.

Supervision Bond:—Cement walks requiring public authority for its construction shall be under the supervision of such authority, or its proper committee, and to such authority the contractor shall be required to execute a good and sufficient satisfactory bond, in the penal sum of 75 per cent of the contract price of the work, payable to such public authority and conditioned, that the contractor shall for a period of ten years next after completion, make good and new such parts of said walks as shall become damaged by reason of inferior work or materials in the construction thereof.

REINFORCED CONCRETE PIER

An amusement pier constructed almost entirely of reinforced concrete costing $500,000.00 is under course of construction at Atlantic City. It will extend two thousand feet seaward and will have an amusement hall, theatre, dance floor, skating rink, etc., in fact will be a general amusement pier of the highest class. The pier will be 175 feet wide, with an offset of 400 feet out to 185 feet wide. The piling and girders will be of concrete, as well as the floor of the theater, the dimensions of which are 191 feet by 75 feet. The deck of the promenade will be of heavy yellow pine such as is used in the boardwalk. One thousand reinforced concrete piles, varying in size from 30 to 45 feet long, by 16-inch octagon, will form the foundation. This is exclusive of the foundation under the theater building which will be made up of cylinders of from 6 to 9 feet in diameter by 20 feet high, filled with concrete. Thirty-nine of the 9x20 foot piers, in addition to the smaller sizes, will form the foundation for this building. Some of these piers are to

CONCRETE PILES FOR CONCRETE PIER.

sustain loads of from 117 to 328 tons each.

In the foreground of the above illustration you can see some of the piling with the forms off, and in the background some still in the forms. The piling shown in the picture is 16 inches across octagon by 36 feet, 2 inches long. Of this size from 18 to 20 are cast per day. The picture shows a Chain Belt mixer at work on this job and Mr. Headly, the contractor, states he finds no trouble whatever in mixing and placing a batch in the forms every 2 minutes.

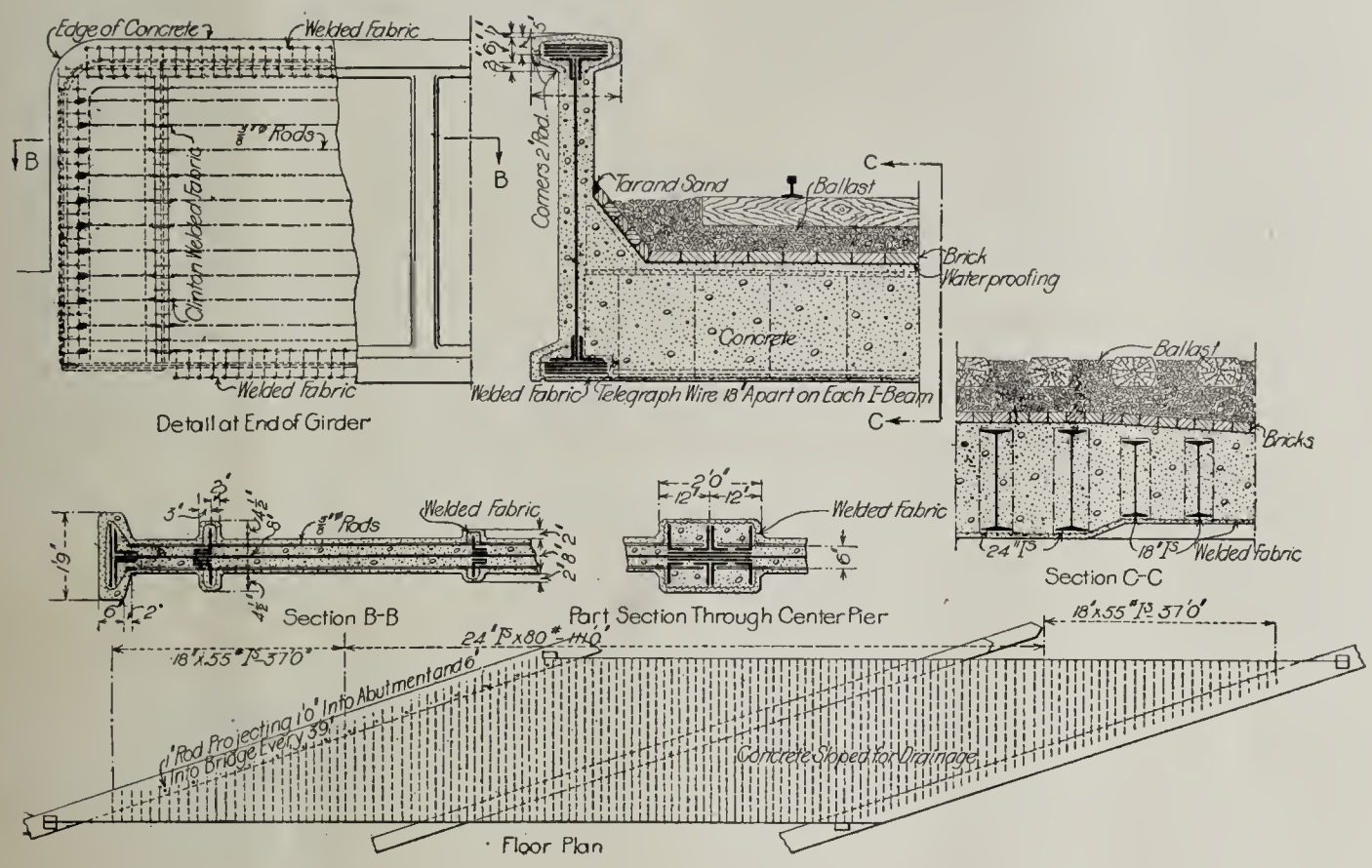
A PLATE GIRDER RAILROAD BRIDGE PROTECTED WITH CONCRETE

At Guymard, N. Y., where the Erie Railroad crosses over the double track location of the Erie & Jersey Railroad, a plate girder bridge has recently been erected which presents a number of novel and interesting features in design. This overhead crossing is made at a very sharp skew by means of two plate girder spans, the steel work of which has been covered with concrete as a means of protection against the heavy blast from trains which pass beneath the structure.

The angle between the intersecting tracks is eighteen degrees and thirty minutes. This sharp skew is illustrated by the fact that the perpendicular distance from face to face of abutments is only 36½ feet, while the over-all length of the superstructure is 128 feet. This length of bridge necessitated the use of two spans supported on an intermediate pier parallel to

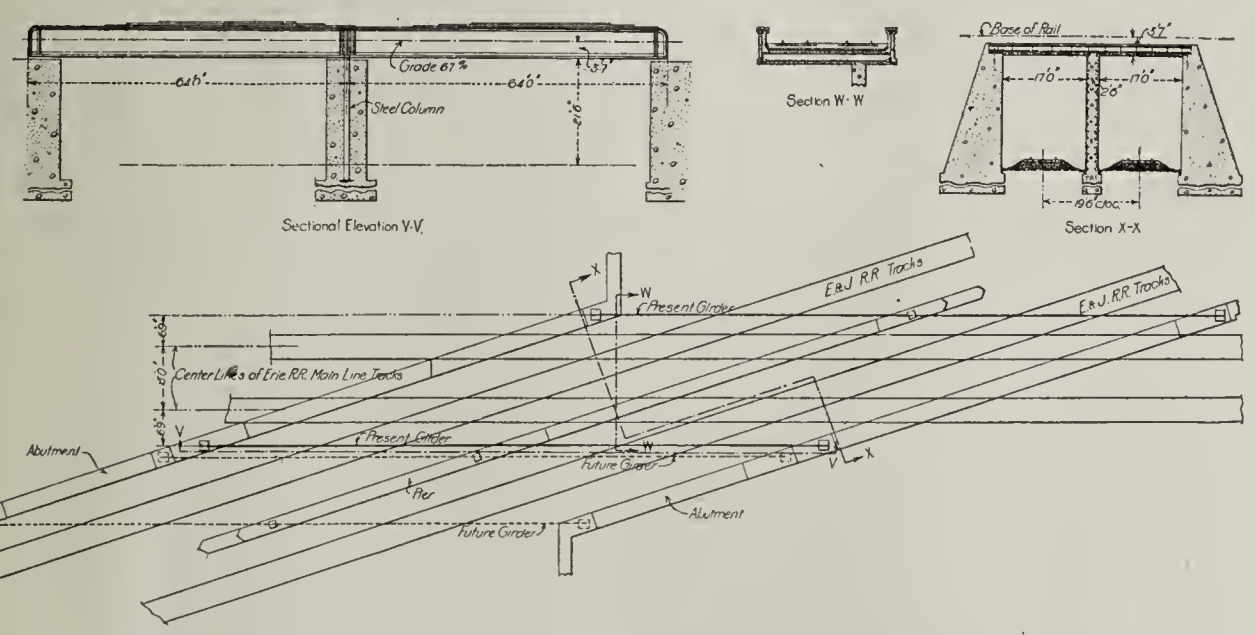
the abutment and located between the two tracks under the bridge. The bridge has been constructed of ample width to accommodate four tracks, although only two tracks are being installed at present. The superstructure has two lines of main longitudinal girders 26 feet apart on centers and 83½ feet apart on a line measured along the face of the abutment.

The girders, which have a span of 63 feet center to center of bearings, consist of 72x¾-inch web plates and flanges, made up of 6x6-inch angles and 15-inch



cover plates. At their ends the girders rest upon unbraced vertical columns, each of which contains four 6x6x¾-inch angles, the flanges of which are turned in and latticed. These supporting columns are encased in a solid mass of concrete which forms the abutments and retaining walls at the ends of the span and which

ends of the bridge are varied in size and spacing in a manner consistent with the shorter span and lighter loading as indicated in the accompanying floor plan. The floor beams are enclosed in a solid mass of concrete, which completely fills the spaces between their webs and which extends 1½ inches beyond the top and



acts as a thin vertical wall or pier between the spans to serve the purpose of a collision fender. The abutments are not reinforced, and have been designed as a gravity section of sufficient size to withstand the lateral thrust from the earth embankments.

The center pier is of concrete, 30 inches thick, and reinforced in both faces by 1¾-inch twisted vertical rods 15 inches apart and ¾-inch twisted horizontal bottom flanges, thus forming a solid concrete floor for the bridge. This concrete filling is reinforced with sheets of Clinton Electrically Welded Wire, 3x8 inch mesh, No. 8 and No. 10 gauge wires. The Clinton reinforcement is suspended ¾ inch below the bottom flanges of the I-beams by loops of ordinary wire not more than 18 inches apart in either direction.

In view of the railroad traffic beneath the bridge,

it was deemed advisable to protect not only the floor beams, but the steel work of the main girders as well. This protection was provided by means of a solid concrete covering, 4 inches thick on each side of the girder web and about 2 inches in thickness around all projecting flanges and angles. This protective covering of concrete is supported upon a steel framework, made up of ⅜-inch rods and Clinton Electrically Welded Wire. The ⅜-inch rods run horizontally through holes in the outstanding legs of the vertical web stiffener angles and are spaced 6 inches apart. Clinton Electrically Welded Wire surrounds all the flanges and stiffener angles and forms an efficient mesh reinforcement to prevent the cracking of the concrete covering under the deflection and vibration of the girders.

The upper surface of the floor is protected with a layer of pitch water-proofing, on which is laid a course of flat hard shale brick. The bricks are laid with ½-inch joints filled with pitch, and extend up the inclined sides of the floor trough. On top of this brick surface is placed the stone ballast which supports the track construction. The concrete in the floor serves merely as a protection for the steel and provides a solid floor to support the ballast between beams. While this construction is quite heavy and requires a total depth of 3 feet 7 inches from base of rail to under clearance, it is, nevertheless, an efficient and economical means of protecting the steel work from the smoke and gases emanating from the trains which pass beneath the structure. The use of a solid concrete floor reduces materially the jar and vibration caused by passing trains, while the protection it offers the steel work will no doubt increase the durability of the structure, reduce the maintenance to a minimum, and prolong the life of the bridge for many years.

The bridge was designed and erected by the engineering department of the Erie Railroad, the work being executed under the direction of Mr. Francis Lee Stuart, chief engineer, and Mr. F. A. Howard, assistant engineer of buildings and bridges.

SAND AND GRAVEL WASHING PLANTS

Paper Read Before Ninth Annual Convention of National Association of Cement Users

By Raymond W. Dull

There has been a very marked change during the last few years in preparing materials for concrete purposes. We now seldom see the old method of sending a team out to a river bank or gravel pit for a load of gravel, and using it regardless of size, proportions or cleanliness. We now see a modern factory for handling, sizing and washing the materials, which decreases the cost of handling, prepares it for different kinds of uses, and best of all, makes it suitable for the purpose.

Unclean material, wtih poor workmanship, has been responsible for nearly all failures. A contractor who is not particular about his materials is seldom particular about his workmanship. It is useless to buy high grade cement, and mix it with gravel having even a thin film of dirt coating the pebbles, for the cement cannot adhere to the pebbles.

The successful method used in the modern gravel washing plant is to agitate the material until the impurities are in suspension in the water, drawing the water off continually, and then rinse the material as it leaves the screens. It is important to leave the water with the material until the last, in order to get sufficient agitation, and that is why separate screens are used for each size.

The writer, after considerable study, developed and applied for patents on the hook-bolt type conical washing screen, which on account of its simplicity, low power, efficiency and durability, has served the purpose exceedingly well.

These screens are set in a series with spouts carrying the sized material to succeeding screens below, while the rejections from the screens discharge from the mouth of the bell into the bins below. The material gets its rinsing from fresh water pipes at the mouth of the screens.

The upkeep of this screen is low, because the bearings and drives are away from the grit and water. The large hook-bolts which support the screen cone do away with all fastenings to the casting, and the screen cones can be changed in less than an hour's time.

I was not, however, satisfied with the progress which this screen made, and developed a still more radical departure in screen construction. Appreciating the advantage gained, if all chain drives could be eliminated, the inclined conical screen was conceived.

All the screens, in this case, are mounted on one shaft, and a pair of gears drives everything. This type of screen differs in its operation from the other screen, for the material is delivered into the large end and travels toward the small end, while with the hook-bolt type the material is delivered into the small end, and travels toward the large end.

The inclined conical screen has the advantage, because the large end does the principal work. The large end has more perforations, more wearing surface, and is, in fact, equivalent to a larger screen. It therefore has greater efficiency, requires less power and has small upkeep. The screens have longitudinal joints, and can be dismantled from the shaft without disturbing the shaft. Walkaways are also provided on both sides of the screens, to make them accessible.

The largest quantity of water is introduced when the material is first starting into the screens, and additional fresh water is added at each screen. The water supply is a very important detail of the plant, and sometimes success or failure depends entirely on this feature. After the material passes through all the screens, the remaining materials are the soil, water and the sand.

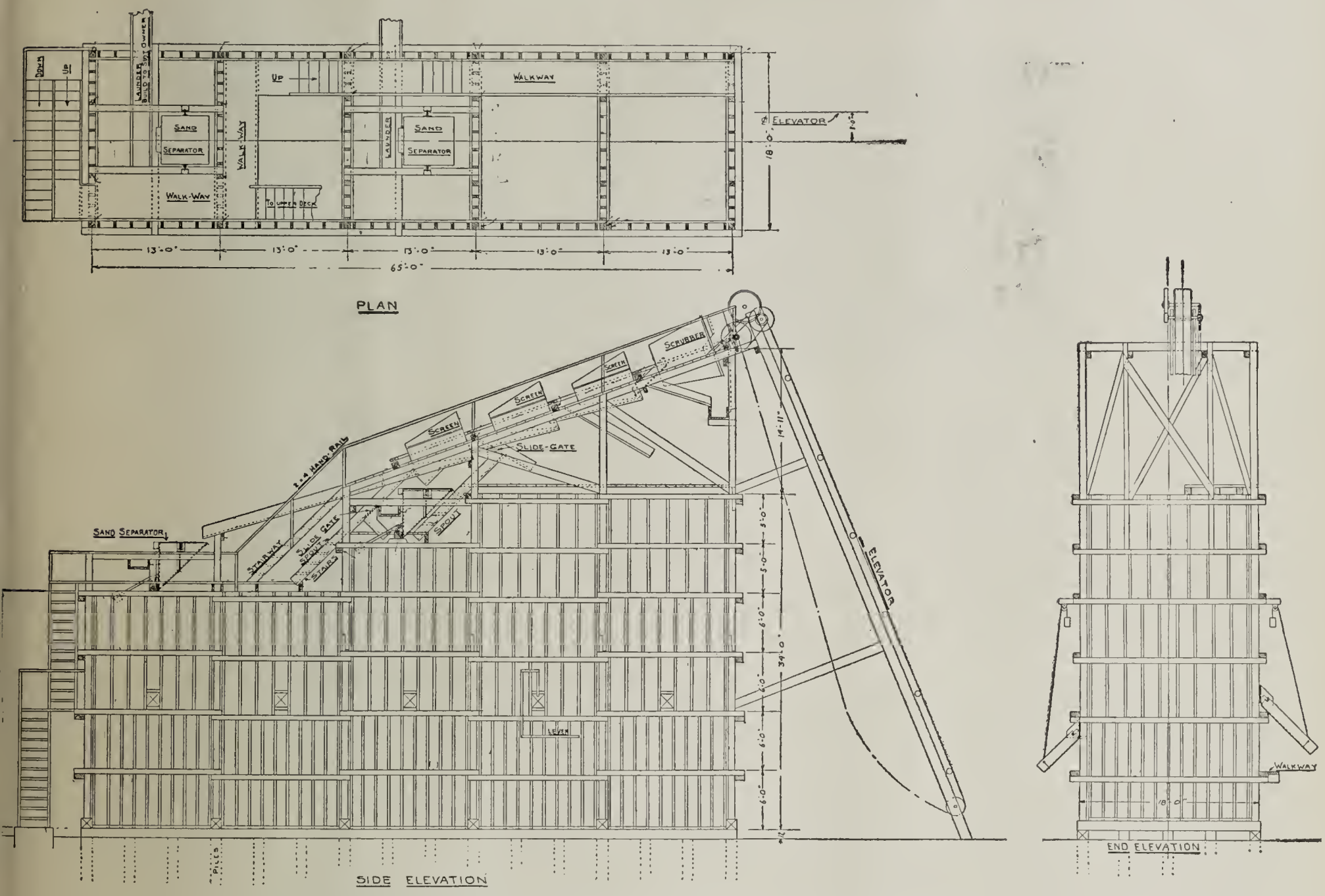
A device extensively used for separating the sand from the soil water is a wooden tilting tank, patented by Mr. Charles Stebbins of Chicago. This tank rocks on two bearings on the sides of the tank. It is divided into two triangular compartments, one for the water and accumulation of sand, and the other compartment for counter-weights, acting counter to the weight of the water and sand.

The valves of the tank consist of pipes, fastened to the tank, with their ends bearing against a fixed timber. When the sand accumulates enough weight, the tank tilts, drawing the pipes from the timber stop, and allowing the sand to escape into the bins below. When a certain amount of sand escapes the tank tilts back, closing the valves.

We are using a modified form of tilting tank made of steel, which is somewhat more sensitive, and designed to permit adjustment of the equilibrium. It consists of a triangular shaped tank, rocking on two knife-edged brackets on the sides, and counterbalanced by a lever and weight. The lever is designed to in-

crease the moment arm of the weight, which retards the tendency to tilt open too far, and does not permit flushing of the soiled water into the sand bin below. The valve castings, which have "V" edges, bear against steel plates, with rubber faces, which are pivotally connected to timber. The operation of these tanks is very gratifying and results are very satisfactory.

I have been asked why it is so difficult to wash sand and gravel in the aggregate. The reason is simply this: When getting rid of the water it must not be allowed to percolate through the material to drain off. To do this makes a regular filter bed operation, and all



PEORIA WASHED SAND & GRAVEL CO.'S PLANT AT PEORIA, ILL.
Designed and Built by Raymond W. Dull Company, Chicago.

the impurities in the water are held in the material. Of course, a constant stream of water can be added, until practically all the impurities are taken away, and then the clear water can be drawn off at the bottom. This means that new material must not be added, and it reduces the operation to a batch or intermittent method. The quantity of water necessary also is excessive. There are devices on the market for mechanically lifting the material out of the water, which produce material washed very well, but the power and upkeep of this class of machinery is very great. It is also impossible to get the water from the aggregate mixture by using a tilting tank, because the gravel will not allow the device to work properly.

I much prefer to wash the material through sizing screens, and then mix together as the material comes from the screens. Here is a picture of a plant de-

signed to segregate the material into separate bins, or combine them together in one bin. One of the owners of this plant is a contractor, using material for re-enforced concrete work, and this design assembles all material, when desired, into the central bin. The material from the first screen is not included, on account of its large size. The proportions are regulated by the slide gates, which cut off so much of the flow and shunt the remainder into the other bins.

Great care must be taken, however, in relying on a mixture accumulated in bins, for the mixture of material may be perfect in the bins, but separated to a distressing extent when the material is drawn from the bin. The coarse material will flow more readily, and go to the far side of the car or wagon, and the fine material, which is more sluggish, will drop into the car on the near side. The result is that one side of the car has coarse material and the other side fine material.

I have so far attacked my washing problems from a mechanical standpoint and appreciate the aid from a chemical analysis. There are some materials which have impurities very hard to eliminate. Some clays will not succumb to ordinary processes. I have introduced what I call a preliminary scrubber for materials unusually hard to wash. It consists of a frusto-conical cylinder, shaped in a manner to retain considerable material and water, which tumbles about as the cylinder rotates. This agitation breaks up the

clay and the worst part of the impurities is carried off before the material reaches the screens.

The belt conveyor is almost universally used on the larger plants for carrying the material to the top of the bins. It is efficient and if properly installed is very satisfactory for this purpose. I have found, however, that the standard troughing idlers wear out very rapidly, handling this kind of material, and I devised a pressed steel pulley with which to equip my idlers. Idlers equipped with these heavy steel pulleys are able to carry large boulders, and as they are split they are readily changed.

Belt conveyors are also used to convey material to the plant from the excavator, and drag-line excavators are coming into use for plants of moderate capacity.

Peoria Washed Sand & Gravel Co., Peoria, Ill. An excellent example of the use of Dull's Inclined Conical Screens in connection with a preliminary scrubber. There are two sand separators. Spouts are so arranged that after separation of the materials they may be mixed in any desired proportions in the bins. The materials are dug from the Illinois River, brought to the washing plant on scows, and delivered to the receiving hopper by a clam-shell bucket outfit. A Symons Disc Crusher made by Symons Bros. Co., Old Colony Bldg., Chicago, reduces the large stones before the materials are fed to the continuous bucket elevator by which they are taken to the top of the plant and fed into the preliminary scrubber.

CEMENT BRICK.

Like other cement products, cement brick is increasing largely in demand. This is due to the poor quality of cheaper clay brick now on the market and the increased prices being charged for the highest grade of pressed brick.

Brick machines are not expensive and some people buy cement brick because they are brick and familiar in form, who would not yet buy the other cement products.

There is also a growing scarcity of good clay brick, which makes cement brick all the more in demand. There are the same advantages attached to cement brick as to the other concrete products and their superior qualities are just as great.

Cement brick are equal to the best pressed brick in appearance—far excel them in durability and strength—and yet sell at a handsome profit to you in competition with the cheapest clay brick.

One bag of cement makes 110 brick. Proportions 4 to 1.

One yard of sand makes 700 brick.

Cement at $1.50. Sand at 75 cents.

	Cost of cement brick per 1,000
Cement	$3.35
Sand	1.00
Labor	1.25
Total	$5.60

They will sell for $8.00 to $10.00.

For a little additional cost brick can be colored any shade desired. The color is put on in the form of a facing, which is economical, and just as durable as if the whole brick were made of the colored matter.

The cost of the coloring varies from 10 to 25 cents per 1,000 bricks. Almost nothing, you see, and the colored brick sell in competition with pressed brick, at prices varying over $20 per thousand.

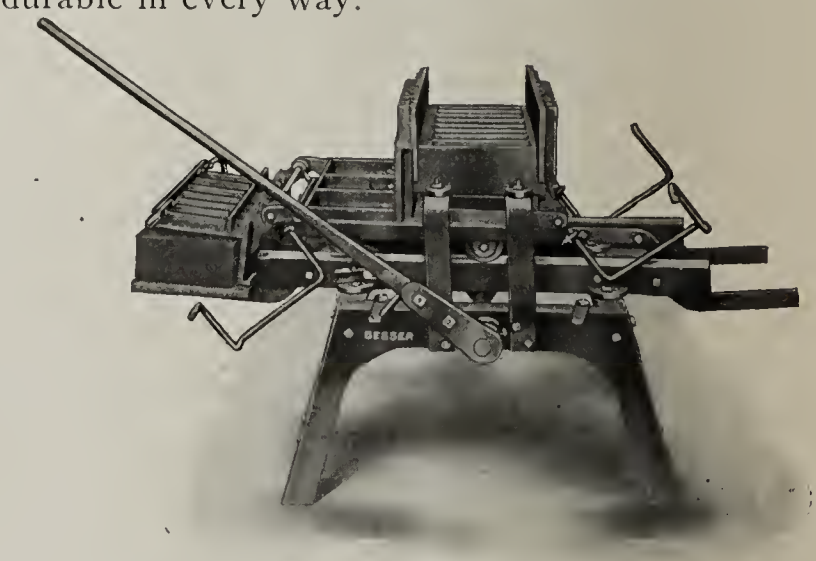
We call your special attention to the pages devoted to the coloring question in the instruction section of our latest catalog, writes the Besser Mfg. Co., 407 Thirteenth street, Alpena, Mich.

LAYING—Cement brick can be laid easier and faster than common brick. In the long run $8 per thousand cement brick is cheaper than $6 per thousand clay brick. Each brick is perfectly true and uniform and it is not necessary to gauge them for first-class work. The cement brick absorbs less moisture than clay, and becomes stronger with age.

When the brick are made on the flat they can be made with considerably wetter material, which will harden up quickly. This method also gives an opportunity, when desired, for using a frog, which is a considerable saving in material.

The product of the Besser Brick Machine is equal or superior to the finest pressed brick and it can be sold in competition with common brick at a good profit.

We have tested cement brick in every way in comparison with the clay brick, and the cement brick absorb less water, stand more fire and are much more durable in every way.



BESSER BRICK MACHINE.

The cut shown herewith is a view of the Besser large capacity brick veneer block and two-piece block machine. This machine has a capacity of 10,000 brick or 2,000 veneer or two-piece blocks per day and is the only large capacity machine of this kind upon the market. It sells at a low price, however, and is the most economical and profitable to operate from every standpoint.

The cuts show that this is entirely different from any other brick or block machine and it secures its great speed solely from the novel and simple way it is built.

Fewer movements and less labor are required to make brick and blocks on this machine than on any other and if you wish to make these products on a large scale and at lowest possible cost, this is the machine you should own.

There are two mold boxes and these swing back and forth under the hopper. That is the only operation. After tamping the brick, a swing of the lever places them ready for removal and the same movement also brings the other mold box in place under the hopper so that the operation of tamping goes on continually and the surplus material always drops into the empty mold.

As the finished mold slides out, you will notice that the side comes to a depression in the track which causes it to gently tip away from the brick and leave them ready for removal. No time lost in releasing and unlocking the brick, which takes as long as the tamping with other methods. No handling of dividing plates. Consider what this means in increased capacity. When the mold slides back, this side comes automatically to place. Thus the only labor is the actual tamping and carrying away. The brick and blocks can be made and delivered just as fast as a man can shovel in the material and this machine will use up as much material as a good man can shovel in a day. Still one man can operate the machine if desired. When mixer is used, we can furnish it so it will spout directly into the machine and thus save shoveling.

INDIANA CORRUGATED CONCRETE FENCE POSTS

Because of the many characteristic properties of concrete, it has, by universal assent, no equal as a material for the construction of fence posts.

Not only has it been tested scientifically, but what is more essential—practically.

It requires no more convincing endorsement than the fact that the largest individual users of posts—railroads, United States government, stock yards and thousands of farmers, are using the concrete post.

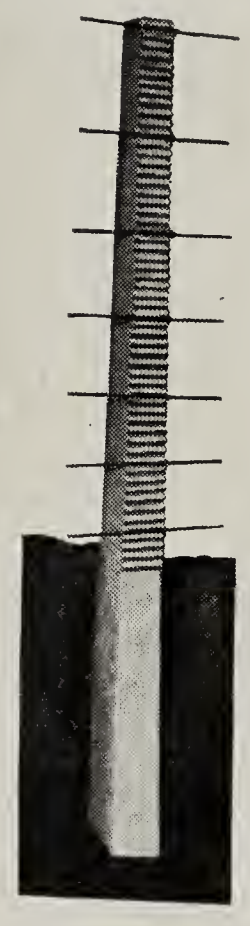
Concrete posts are easily and quickly made, become harder and stronger with age and are practically indestructible. Do not rust as steel, or burn or decay like wood. They are impervious to the action of wind and rain, neither will they heave with the frost and they require no painting or repairing and the fence is readily attached.

Concrete posts are attractive in appearance because of their uniformity in size and color, and because of their durability, they effect a saving in giving greater life to the fencing material used, so that the permanent value of the property is increased.

The Indiana Post is made square in shape with corrugated face. These corrugations are not sunken into the post but project a half inch, thereby retaining the full size and strength of the post. Our standard line posts are 7 feet long by 5x5 inches at bottom and 3x3 inches at top; weighs 90 to 95 pounds.

The square post is the strongest post made, more square inches of concrete and better chance for reinforcement to be placed where it will add the greatest possible strength.

A fence fastened to the Indiana Post cannot "slip up or down" as the corrugated face holds it firmly. This is a valuable feature because it keeps the fence from sagging and where the ground is rolling and hilly will not allow the fence to slip up the post, thereby leaving considerable space under the fence through which stock may pass. Our method of fastening the fence to the post is by use of tie wires, writes the Indiana Concrete Mold Company, 25 W. Canal street, Peru, Ind., who manufacture the mold for making corrugated fence posts. These wires should be No. 12 size and may be easily applied by the use of ordinary lineman's pliers, which can always be secured at any hardware store.



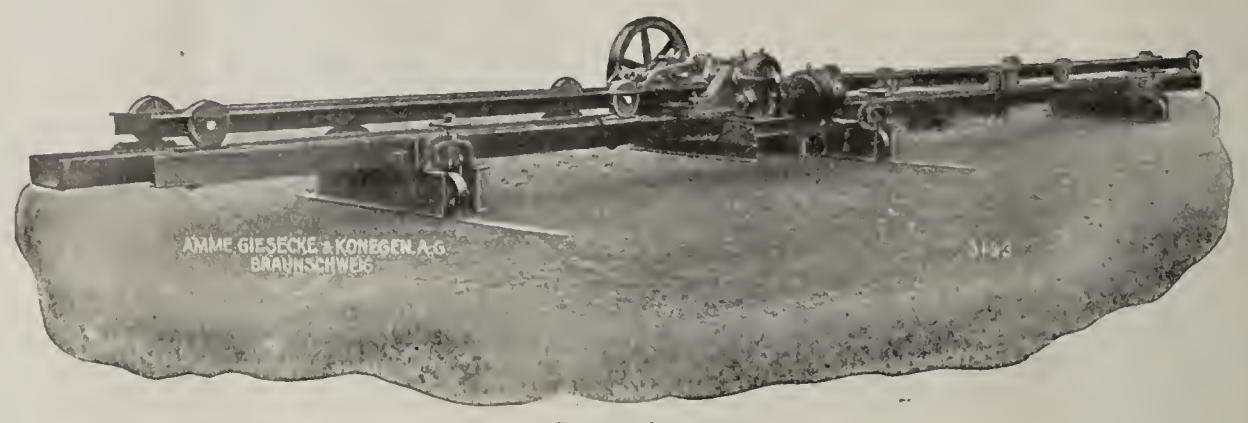
The Indiana Post Molds are furnished either in single molds, with cast iron ends, or in table type steel frame batteries. Our single molds are made of No. 18 gauge sheet steel formed in such a manner that the instant the cast iron ends are removed from the mold, the spring of the metal separates the mold from the concrete. Each mold is supplied with a corrugated strip of sheet steel, which forms the corrugations on the face of the post. These corrugated sheets are not fastened to the mold, but lay in the bottom and always come out with the post, and may be removed without the least possibility of pulling any of the corrugations from the post.

The ends of the molds are provided with cast iron end plates, made with a rib extending along the top edge so as to make it easy to remove the plate when the mold is to be released. At each upper corner of the end plates are small round lugs, which pass through holes provided in the flanges of the molds, holding them securely together and also preventing the end plate from moving out of place. The mold is released from the concrete by lifting the end plates upward from the mold, the spring formed in the metal causing the mold to separate readily from the concrete.

When posts are to be made rapidly any number of these single molds may be used. For convenience it is best to have a common wooden trestle about 24 inches high, upon which to rest the molds while being

THE TORPEDO CONVEYOR

Cuts Power and Repairs



Patented

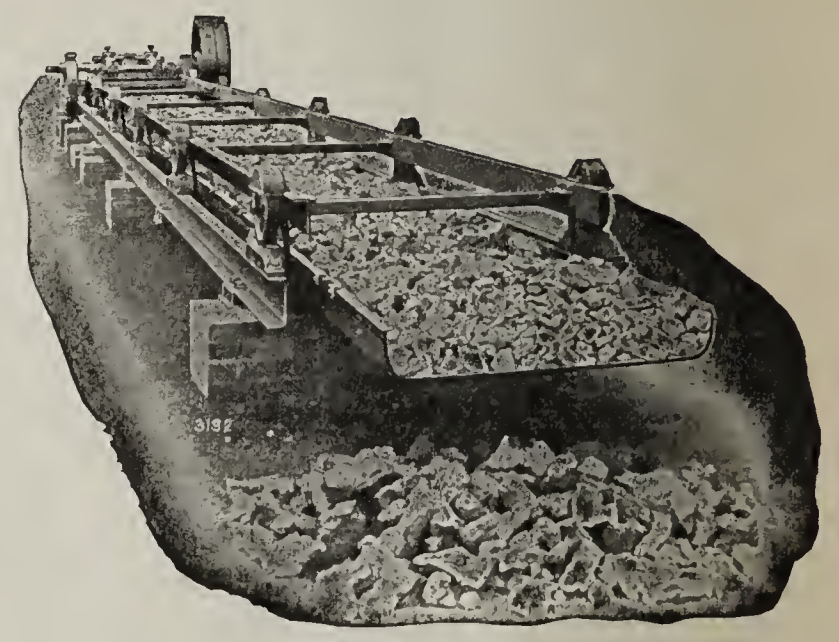
Conveyor

THE Torpedo Conveyor consists of a trough which is suspended from a carriage. This carriage rests upon wheels supported on short pieces of track resting on cast iron supporting brackets. A motion forward and back, is given to this carriage by means of a crank. Underneath the trough, or conveyor, there is a pneumatic cylinder, the piston rod of which is attached to the bottom of the trough and given a reciprocating motion by the conveyor trough. The forward motion of the conveyor compresses the air in this cylinder. At the end of the stroke this compressed air gives to the conveyor trough a quick reverse motion.

The pendulum arms by which the trough is supended from the carriage are in a vertical position at the extreme backward point of the throw of the crank, so that the motion of the trough on the forward stroke of the crank is forward and upward and on the return stroke is downward and backwards. This peculiar motion causes the conveyor trough, upon the return stroke, to drop away from the material which it contains and thus prevents friction or wear on bottom of trough.

It will therefore be seen that the movement of the conveyor trough is quite different from that of any shaking launder, or shaking screen and that the motions by which the material is carried forward and the trough itself returns are peculiar to this conveyor.

Simplicity in construction is one of the special advantages of this Conveyor, and fewer repair parts are required to keep it in constant operation. It is especially to be noted that the Conveyor may at any time be extended in either direction without change in drive.



Costs

The driving apparatus may be placed at any convenient point in the Conveyor or at either end. Material may also be fed or discharged to it at any point throughout its length.

Chalmers & Williams CHICAGO HEIGHTS, ILLINOIS

filled with concrete, usually filling six to ten molds at a time.

Proper Material for Concrete Posts

Gravel just dug from the pit is sometimes, though very rarely, found with the right proportion of sand and pebbles. The mixture best suited for posts is two parts sand and four parts pebbles, in which all sizes less than one-fourth of an inch in diameter are considered sand. All over one-fourth of an inch in diameter are pebbles and none should be larger than one inch in diameter.

Gravel should contain no decayed stone and should be clean in order that the cement may adhere to it. In some localities crushed stone is used instead of gravel. The most desirable crushed stone is that which is clean and hard, which breaks with a sharp angular fracture and to which the cement will easily adhere. Crushed rock should be screened only enough to remove the dust.

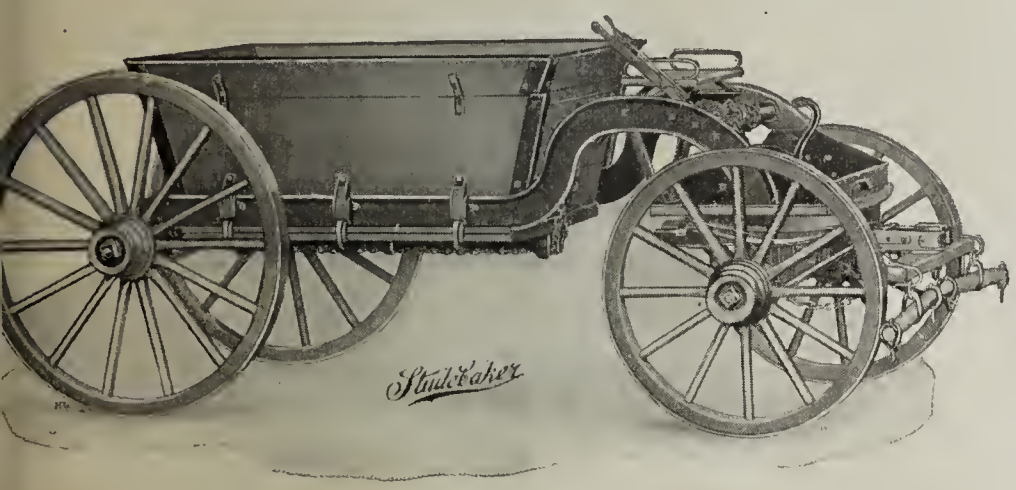
The small particles are not a detriment but a decided advantage, since they reduce the amount of cement mortar required and give the post additional density in strength.

As for the amount of cement used for either gravel or rock it should be in a proportion of one part cement to four parts aggregate and thoroughly mixed.

A NEW DUMP WAGON

A new dump wagon, specially designed to secure strength and durability, is shown in the accompanying illustration.

The wagon is made in two models, known, respec-



tively, as the Studebaker steel frame bar axle dump wagon and the Studebaker steel frame steel axle dump wagon, the two being the same except in the construction of the axle. Both are made regularly with a capacity of 1½ cubic yards, but are furnished also with 2-yard bodies. The frame is of steel, the side bars being channels bent at the front, as shown, to permit the forward wheels to turn under. The body is of hard wood, with sides 1½ inches thick, dovetailed and grooved. Angle irons are used along the corners of the sides and wings, and bands are used on edges of both sides and wings. The wagon is of the bottom dump type, the doors being covered with steel with an overlapping strip in the center and with angle irons along the sides and ends. They are operated by the dumping and winding device used on the company's "Ideal" and "Hoosier" dump wagons.

The rear wheels are 54 inches in height and the forward wheels 42 inches. The forward truck is mounted upon a 28-inch full circular oscillating fifth wheel, so arranged as to permit the front wheel on each side to drop into a depression or pass over an obstruction without throwing the body out of a level position. The wheels have birch hubs, white oak spokes and rims and 3 inches by ⅝ inch tires.

The wagon is approximately 4 feet 3 inches high from the ground to the top of the bed and 4 feet 9 inches high to the top of the wings. It is equipped with either a drop or stiff pole and with neck yokes or chains. The seat is mounted on springs and supplied with hand holds on the ends. Extras with which the wagon may be equipped include a brake, steel or steel and asbestos lining, 3-horse hitch, extra wide tires and hinged top box. It is manufactured by the Studebaker Corporation, South Bend, Ind.

A GYRATORY-JAW CRUSHER

The Universal Crusher Company, 304 North Third street, Cedar Rapids, Iowa, is putting upon the market a line of crushers which combine in their crushing action the advantages of both the gyratory and the jaw type of crusher. In appearance this new type of machine resembles somewhat a crusher of the ordinary jaw type; but the action of the crushing pitman is vertical as well as horizontal, producing a grinding motion and a forced feed and forced discharge, which the ordinary jaw crusher does not possess. The manufacturers claim for this machine several advantages over the gyratory type of crusher:

First, the small amount of power required to operate, the 80-ton a day machine requiring only 10 horsepower, and the 250-ton size requiring only about 20 horsepower.

Second, the uniformity of the product. Recent tests have shown over 95 per cent of product to pass a given ring, so that a rotary screen is not necessary as in other crushers to divide the stone into different sizes. The percentage of dust can be removed with a chute screen.

Third, the Universal Crusher can be instantly adjusted, without changing any parts and without even stopping the machine, to produce any required size of product. Facing material ¼-inch can be as easily produced as 2½-inch or 3-inch road foundation.

Its simplicity of construction makes this machine of very few parts and light in weight so that it can be manufactured and sold at a very low cost. The company, although still very young, has already scored a great success. The smaller sizes of machines are in wide use in block and tile plants for taking care of waste and for making facing material, since they handle gravel and granite with as great ease as limestone and softer material. The medium-sized machines are being adopted by builders and contractors, their light weight and simplicity of construction giving them a special advantage.

BULLETIN ON JAW AND GYRATORY CRUSHER PARTS

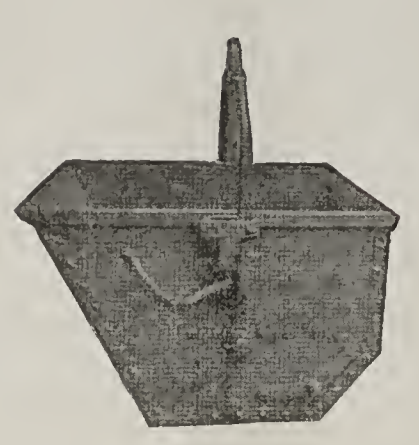
Bulletin No. 56, "Gyratory and Jaw Crusher Wearing Parts," issued by the Edgar Allen American Manganese Steel Company, Chicago, Ill., is now ready for distribution. This bulletin treats upon the use of Stag manganese steel in crushers. Among other things, a description of the extensively used types of crusher heads is given. One of them, "The Hunt Nut-Locked Mantle head" is illustrated herein.

This bulletin also contains cuts and descriptions of the Black Ventilated, Allis-Chalmers Gunlock mantle heads and McCully type mantle head.

Bulletin No. 56 will be of interest to all users of gyratory and jaw crushers. Copies will be sent promptly upon request.

CONTRACTORS' BUCKETS

The Biehl Iron Works, 146 Spruce street, Reading, Pa.. the oldest company in America manufacturing buckets, have just issued a new catalog giving illustrations, sizes and prices of their buckets for handling concrete, gravel, etc., which they will gladly send free of cost to readers of Cement & Engineering News. "If you visit our shops you would not know you were in the oldest shop in America manufactur-



ing buckets," writes Mr. Biehl, "for the machinery and methods used are the most modern. Constant improvement has been our policy for 60 years. It's the reason we have built up such a large trade."

The Biehl Iron Works has recently patented their R. and B. controllable bucket especially adopted for pouring concrete over floors or roads; for pier and deep caisson work. It is very simple to operate and can be sold at a trifle over half of what other manufacturers ask for a Two-Door Controllable Bucket. It is controlled by one lever, placed on the side so that operator can see and control contents of bucket dumping into narrow forms, and so that contents can be dumped out gradually at operator's will. The feature of this bucket is the lever mechanism. The operator can control lever with one hand and steady the bucket with other. A slight push is all that is necessary to open the doors, but the lever mechanism is so designed that the load itself will not open them even if the lever is not latched. The lever can be held at any position without latching when the load is dumping. Dumps clean and material can't cling to doors in closing. Made in four sizes: ½, ¾, 1 and 1½ yards. This bucket is illustrated in their new catalog.

CONCRETE BURIAL VAULT INDUSTRY

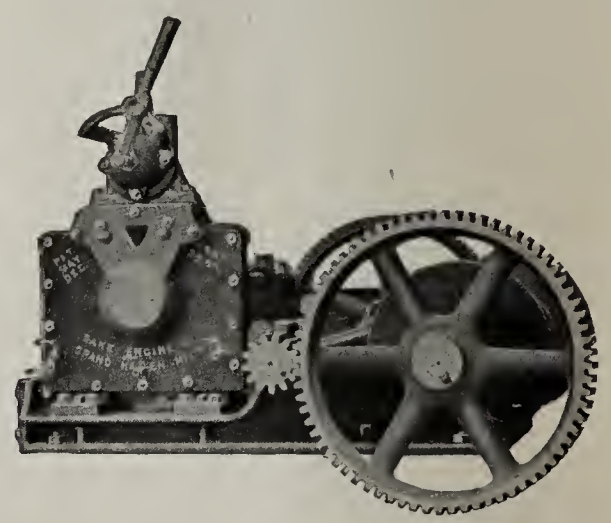
The use of concrete burial vaults during the last few years has increased at an astonishing rate, reflecting a demand caused in part by the general development of the Concrete Industry—a demand for concrete products of all kinds. Then there has never been a period during which the undertaking profession has made so great progress in all departments as in the last ten years; consequently a much higher grade of funeral furnishings of all kinds are being used now than ever before, and therefore there has been an increased demand for a higher state of perfection in burial vaults. Then again, the public in general are being educated out of the old-time method of burying with only an ordinary wooden box to protect the remains; and along with this education has come a spirit of investigation as to what kind of burial vault is best, the result of all this being that the concrete vault is more in demand than any other.

The Automatic Sealing Vault Co., of Peru, Indiana, has not been slow in realizing the truth of the above statements, and has spared neither time nor money in bringing the Automatic Sealing Vault up to the highest standard of perfection.

At the time this vault was invented, there were a number of two-piece concrete vaults, besides several sectional vaults, on the market; but all belonged practically to the same class, as they all depended on having their different sections cemented together in order to make them water-tight—a process which is of doubtful efficacy for the simple reason that the chemical action which hardens a mass of concrete by causing the elements of which it is composed to crystallize is exhausted in the process; and any attempt to unite two or more sections of seasoned concrete with fresh cement simply results in a chemical action taking place in the fresh cement only, causing it to crystallize, but the sections are not united as there is no affinity in a mass of seasoned concrete for the elements of which it was originally composed. The fresh cement may cause the sections to adhere together; but the old joint still remains, through which the water, it is claimed, will eventually filter.

THE DAKE SWINGING GEAR.

The cut shown herewith illustrates the Dake Swinging Engine, which has been designed to meet the wants of contractors and owners of quarries and gravel pits for a machine to handle derrick booms. The swinging engine is wide enough so it can be bolted to the skids extending in front of a double drum hoist, the swinging drum being placed low on the frame to allow plenty of clearance for the hoisting lines. The gear is driven by a Dake reversing engine,



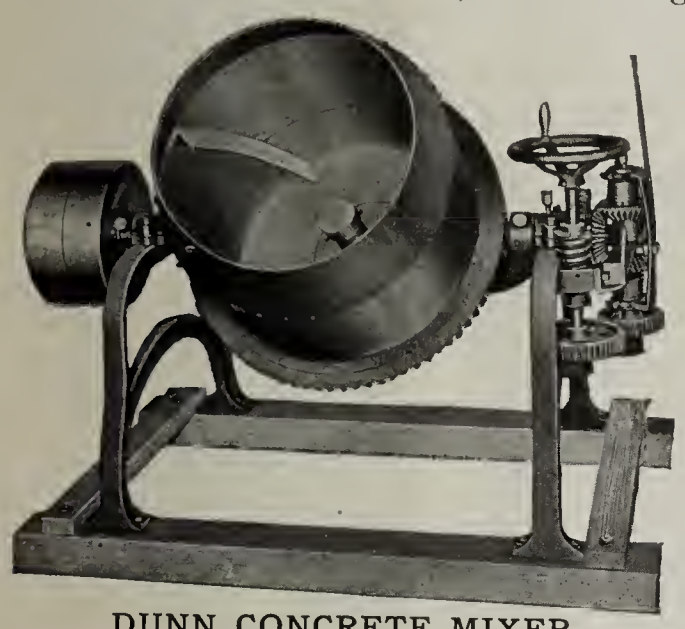
which has no dead center, and will start, stop and reverse at the will of the operator. Prices, catalogs and information will be furnished to any one of our readers by addressing the Dake Company, care of Cement and Engineering News, 1117 Schiller Bldg., Chicago.

NEW BOOK

"Concrete Sidewalks, Pavements, Curb & Gutter," a book recently issued by the Universal Portland Cement Company, covers briefly the underlying principles of good design and good construction and includes the specifications of the National Association of Cement Users, as presented at their December, 1912, meeting. The broad policy of the Universal Portland Cement Company in making a wide distribution of helpful books has done much to assist contractors in planning better methods of work.

MACHINE MIXING

In making a good quality of cement products, it is very essential to have a batch mixer, using exact proportions of sand and cement, doing the mixing in full view of the operator and not discharged until perfectly mixed. The Dunn Utility Mixer shown herewith will do all this, and can be absolutely depended upon to mix any kind of concrete, wet or dry. It is well built, reliable, substantial, and will stand the test of hard, practical usage. The W. E. Dunn Mfg. Company, 4139 Filmore street, Chicago, who manufacture this machine, will be glad to send a new book free to any readers of Cement & Engineering, which gives illustrations and details concerning this mixer.



DUNN CONCRETE MIXER.

KANSAS ENJOINS SAND COMPANY

John S. Dawson, attorney general of Kansas, came to Kansas City yesterday and filed a suit in the District Court of Wyandotte County against the Stewart-Peck Sand Company of Kansas City, Mo. to compel an accounting from the company for all the sand taken from the Kaw River during the last ten or twelve years. The suit is also an injunction against the company taking sand from the Kansas streams until an inspector can be provided to see that the accounting is made and maintained.

The suit in reality was brought to forestall any action the sand companies were preparing to bring in the federal courts to stop the enforcement of the state Sand Royalty Law enacted by the last legislature.

The sand companies have been talking of how they would cheerfully comply with the law and pay the royalty. But the attorney general received some information yesterday that indicated the sand companies were going into the United States courts to obtain an injunction against the state.

The suit was brought to collect a royalty on all the sand taken from the Kaw River by the Stewart-Peck Sand Company during all the years it has been in existence. It is a Missouri corporation and since 1905 has been licensed to do business in Kansas. It is asserted by the attorney general that the company has taken enough sand from the Kaw River to entitle the state to a royalty of more than $100,000 previous to the law going into effect, and $10,000 for sand taken since April 30.

NEW BOOK

A valuable 100-page book on "Reinforced Concrete Pavements and Roadways" has been published by the American Steel and Wire Company, 72 West Adams street, Chicago, and is sent free upon request.

Proof extraordinary that Goodrich Conveyor Belts give longest service

Orders in rapidly increasing volume are coming to us for belts to be shipped to foreign countries.

LONGLIFE CONVEYOR BELT

has been shipped to Canada, Newfoundland, Mexico, Panama Canal, Colombia, Chile, Argentine Republic, England, France, Belgium, Germany, Austria, Russia, Sweden, South Africa and Australia.

This increasing use of "Longlife" in the face of strenuous competition, is forceful proof of the superior service given by the belts of Goodrich make.

Just look at this two week's record

During the first two weeks of March ten orders were received for Germany and Austria, a big dredge belt was ordered for Ural goldfields, Russia; large belts were ordered for Japan and South Africa, while Canada and Mexico also sent good sized orders.

Specify "Longlife" in your next requisition

There's a reason for all these orders from abroad. That reason is the fact that "Longlife" Belts operate right, give continuous service and handle more tons per dollar cost than any other belt.

The B. F. Goodrich Company

Makers of Goodrich Tires and Everything That's Best in Rubber

Factories: Akron, O. Branches in All Principal Cities

There is nothing in Goodrich Advertising that isn't in Goodrich Goods

WASHING PLANT

Of the Palmyra Sand Company Presents an Unusual Arrangement Which Has Proven Highly Satisfactory.

The Palmyra Sand Company, of Palmyra, N. Y., has in operation an up-to-date sand and gravel washing plant which was designed by Raymond W. Dull & Co., Chamber of Commerce Bldg., Chicago, who also furnished the machinery for the plant.

The plant is located about a mile east of Palmyra, on the old Barge Canal. It was built to furnish material for concrete work in connection with the new $100,000,000 Barge Canal through New York state, and only two sizes of material are used, viz., sand and gravel.

The bins are on the canal bank, and a barge can be loaded very quickly by opening several gates at the same time, as the old canal can be used for transportation. The freight arrangement is very satisfactory.

The gravel bank is about 30 feet deep, and their present property adjacent to the plant consists of twenty acres. The overburden is very light, in many places less than a foot deep, and so far no stripping has been done, as the screens are so efficient that all loam is taken out and the material passes the inspection of the state engineers.

The capacity of the plant is 1,000 yards of material per day of ten hours. The gravel bin is very large and is 90 feet long.

The digging is done by a Thew steam shovel, and the material is brought to the plant in 4-yard side-dump cars, which dump into a hopper at the plant.

The material is delivered from the hopper into a 30-inch belt conveyor, which elevates the material sufficiently to deliver into a revolving screen over the crusher. This method permits crushing the material while it is dry, and makes it unnecessary to elevate the material twice, as is the case with most plants.

The material which passes through the screen, as well as the crushed stone, is delivered on to a second 30-inch belt conveyor, which elevates the material to the washing screens. The water is added at this point and the material is divided and washed by two improved quick-change washing screens. The gravel is delivered onto a 30-inch conveyor over the bins, which discharges it into the bins by means of a movable tripper running on a track like a car.

The sand and water go into two automatic settling tanks, which take out the sand automatically and deliver it into the bins beneath. The refuse and water are carried across the canal into low lands beyond.

The belt conveyors are all equipped with pressed steel idler pulleys, and the crusher is a No. 5 Gates. Power is furnished by a 125-horsepower high-speed automatic cut-off engine and 160-horsepower boiler.

View of sand and gravel plant at Grand Rapids, Mich., of G. W. Bunker Co. Bins of reinforced concrete. Equipment is entirely enclosed affording protection to men and machinery. Materials dredged from bed of river and handled by an orange-peel bucket outfit. The Raymond W. Dull Company, Chamber of Commerce Bldg., Chicago, designed and installed the complete plant.

SAND AND GRAVEL PLANT

The Vigo Wash Sand & Gravel Company, of Terre Haute, Ind., has built a new sand and gravel washing plant to operate on the Wabash river. It has purchased pumping machinery from the Morris Machine Works and new screening machinery from Raymond W. Dull Co., Chamber of Commerce building, Chicago.

The dredge boat is seventy feet long, and after screening the gravel will be loaded directly on the barges, of which there are six in number, two more to be added later.

The tramway was manufactured by the Link Belt Company, Chicago and Philadelphia, and is 365 feet long, having a boom extending over the river about 50 feet, thus allowing two to three barges to be placed abreast.

The unloading will be done by a 1½ yard clam shell running from barge to storage ground. The daily capacity is 1,000 yards of washed and screened sand and gravel a day.

➢ FLINT-RIM ➣

Sprocket Wheels, Rollers and Truck Wheels for Conveyors, Carriers, Trucks and Cars

➢ FLINT-RIM ➣ sprocket and wheels are made by a special process, perfected by us after many years of investigation and experience. They give a hard, smooth bearing surface, free from sand. This surface extends to a depth of ¼ inch to ½ inch and prolongs the life of the wheel far beyond that of ordinary cast iron. The life of sprocket wheels made by the **➢ FLINT-RIM ➣** process is prolonged because it not only insures but *maintains* the correct diameter and pitch.

The most economical sprocket wheel for handling abrasive and gritty materials.

CATALOG ON REQUEST

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Boston	131 State Street	Birmingham	General Machy. Co.	New Orleans	Wilmot Machinery Co
Pittsburgh	1501-3 Park Building	Seattle	512½ First Avenue S.	Los Angeles	204 N. Los Angeles St
St. Louis	Central National Bank Building	Denver	Lindrooth, Shubart & Co.	Minneapolis	Link-Belt Supply Co

Swimming Pool in Residence Mortimer L. Schiff, Oyster Bay, L. I.
Waterproofed with CERESIT.

"Ceresit" Waterproofing

Makes Concrete Permanently Watertight

Thousands of jobs of cement construction all over the world in buildings, retaining walls, foundations, tunnels, reservoirs, pits, roofs, viaducts, acqueducts, tanks, pools, floors, basements and exterior wall surfaces, have been made permanently waterproof by mixing Ceresit with the concrete or cement plaster.

This letter would not reach us if Ceresit was not satisfactory cement waterproofing.

CERESIT WATERPROOFING COMPANY,
446 Commercial Nat'l Bank Building, Chicago, Ill.

Chicago, April 25, 1913.

Gentlemen—Referring to your letter of the 23rd inst., we would say that we used your CERESIT for waterproofing in concrete mass at the Horlick's Malted Milk Company plant at Racine, Wis., for the tunnel work and elevator pits, and found it to be satisfactory in every respect. Yours very truly, HENRY APPEL & SON CO.

AGENTS WANTED IN UNOCCUPIED TERRITORY

Ceresit Waterproofing Co. Clark & Adams Sts., Chicago

Branches: 1218 S. Chestnut St., Philadelphia, Pa. 1133 Broadway, New York City, N. Y.

Ceresit factories are located in Chicago; Unna, Westphalia, Germany; London; Paris; Vienna; Warsaw, Russia

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REMINDER

to write Ceresit Waterproofing Co., Clark & Adams Sts., Chicago, for Book "Q" on Waterproofing, Concrete and Cement Mortar.

WATER AS AN ELEMENT IN CONCRETE CONSTRUCTION

By H. A Mark

The occasional failure of important concrete structures, when subjected to floods or other unexpected conditions, indicates that low cost and profits are given more consideration than strength and durability. Then, again, from the writer's observations of the work of others, he is led to believe that while a careful study has been made of cement, sand, and aggregate, the function, purpose, and effect of water in the mix is little understood.

Cement, sand, and the coarser aggregates are inert solids without cohesive or adhesive power. Water, on the other hand, is a fluid without adhesive or sticking power to join two substances together. But water has a very strong surface tension. This is exhibited in what is known as capillary attraction. It is water that binds the inert materials together. This binding power is greatest when every particle of cement, sand, and aggregate is covered with a continuous film of water. If too little water is present, or if it is not evenly distributed, the water film will be broken. If, on the other hand, the thickness of the film is increased to the filling of the interstices between the aggregate this binding power decreases until it is nothing when the solid particles of the mix become immersed in the water.

In addition to being a binder of the solid elements of the mix, the water acts as a lubricant, allowing the solid particles to slip on one another and assume positions resulting in smaller interstices. This increases the density of the mass, and also the capillary attraction of the water film, provided there is not sufficient water present to destroy this film tension. When the excess of water destroys film tension the solids become separated or "suspended" in the fluid. The finer particles of cement "float" in the water filling the interstices or settle from the mass on agitation, and at the same time the "lubrication" of the larger particles is not increased.

It is the finer particles of the cement that develop the greater strength, but when suspended in the fluid or separated from the mass, the "hands" of these particles are not sufficiently long to bridge the water gap separating them from one another or from the larger solids.

This film tension and lubrication can be easily illustrated by a couple of pieces of window or ground glass. Press together and separate by drawing apart at right angles to the plain of contact. Repeat the experiment with the glass dry, coated with a thin film of moisture, and immersed in water.

It is far easier to build up the water film by careful addition of water than it is to distribute the water after it has been added. If excess of water is added to one part of the mix, so as to "float" the fine particles of cement, it is a question if the film tension can be restored by mixing this with drier materials. This kind of concrete may appear all right, but one part of the mass will not be sufficiently lubricated so the solids can assume the positions for greatest density, and the other parts will be over wet so that the particles of solids will be separated by excess water, and film tension will be lacking in either case. When water is poured or flows from a pipe or nozzle, this is sure to be the effect. The less nearly the cement fills the interstices of the aggregate the more pronounced the effect will be from improper watering. When the water is in just the right proportion to furnish the lubricating effect and the greatest binding power, these forces tend of themselves to draw the particles together into the dense mass.

The third property of water in concrete is to furnish the element that causes crystallization of the cement, giving to the concrete its strength. The observation of the writer leads to the belief that the crystal takes the best form when the water is present as just described. But this will not give sufficient water for the complete growth of the crystal. More water must be fed it during the time of curing in order to grow it to maturity.

So far we have dealt with only the ideal or theoretical requirements. Among all the methods, manners, and systems of mixing concrete, there can be only one right, or ideal process for each particular combination of materials to develop its maximum strength and durability. But this may not be the most economical from the cost standpoint. A given aggregate with a given proportion of cement will, when properly handled in the watering and mixing, give a definite result. But it may be more economical to increase the cement content and do the work in a manner that will not develop the maximum strength. But until one knows the requirements of developing maximum strength, and the question of water is one of the greatest of these, he runs great risks in attempting to sacrifice construction efficiency to profits and low cost of construction.

The writer has used much bank gravel in concrete construction. He has found it economy to screen the fine from the coarse aggregate. Mix the fine aggregate and the cement, and then mix this with the coarse aggregate, thoroughly drenched. Following thorough mixing, water as needed, is added by sprinkling until tempered to the proper consistency. The sand, fine aggregate, should be just sufficiently damp to cause the cement to adhere. This dampens the cement and establishes capillary attraction. The coarse aggregate has but little capillary attraction and, on mixing, its excess of water is taken up by the superior attraction of the finer materials. In this way the material is all bound together.

If the water is added to the mix of cement and sand, making a mortar into which to mix the coarse material, a very poor bond is established between the two classes of materials. If all of the materials are mixed together before the addition of water, it is very hard to add the water without washing the cement from the larger particles or drowning the cement and fine sand. What has been said of sand and gravel is equally true of sand and broken stone.

With proper watering and curing the same strength is developed with one-half the cement as with improper watering. And when the work is properly managed the cost is very slightly increased. This is true of either hand or power mixing. It is simply a question of whether it is best to add brains or additional cement to the mix.

CONCRETE POLES

The Rochester Railway and Light Company, Rochester, N. Y., is to erect a new factory for the manufacture of concrete poles in Atlantic Avenue. The plant will be 40 by 80 feet and one story high and will enable the company, with the help of the establishment on Wolcott road, to produce 2,000 poles yearly.

U. S. STANDARD CONCRETE MIXER.

THE SENIOR "A"

Is Accurate in Proportioning the Materials.

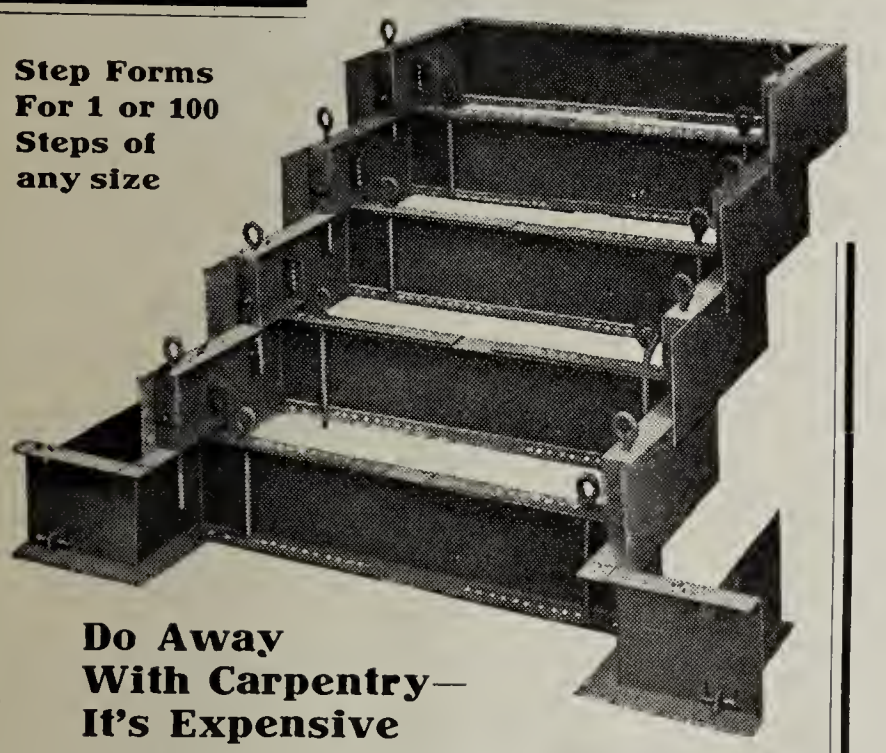
Mixes Dry Before Water Is Supplied Giving Thorough mixed, Uniform Product.

Capacity 7½ Yards Per Hour. Other Sizes in Stock at all Times.

Ask for Bulletin 21 and Mention Cement and Engineering News When Writing.

R. R. REED, General Sales Agent, ASHLAND, OHIO.

Step Forms For 1 or 100 Steps of any size



Do Away With Carpentry— It's Expensive

You can't afford to waste time on wooden forms if you expect to do your share of concrete step construction this season. No two sets of steps are alike in dimensions, and to build new forms for each job, it would require a big share of your time and profits. Before the season sets in, better look into the merits of the

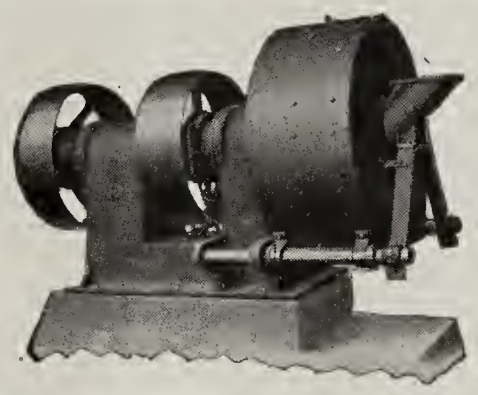
Indiana Adjustable Step Molds

Adjustable to all sizes, enabling you to use the same forms on hundreds of different sized jobs. They are complete in themselves, not simply form holders, but a complete set of molds for molding concrete steps.

Circulars and prices on request.

Indiana Concrete Mold Company

25 W. Canal St. **Peru, Ind.**



Symons Disc Crushers are winning repeat orders in the largest crushing plants of the country; in well known mines in many parts of the world; where CAPACITY and DURABILITY count.

Disc Crushers follow first breakers.

Reduce the output to small sizes.

Capacity 48″ size crushing 7″ stone to 1″, 50 to 60 tons per hour.

Adjustable. Made in five sizes. Careful attention to your inquiry.

ADDRESS:

Symons Brothers Co.,

1390 Old Colony Bldg., CHICAGO

THE SUCCESSFUL GASOLINE ENGINE FOR DRILLING PURPOSES MUST BE A SPECIAL ENGINE

When purchasing a drilling machine from a manufacturer who is supplying a gasoline engine not manufactured by him, you must bear in mind that, should engine trouble develop, the purchaser is often up against a proposition of not being able to secure repairs and satisfactory information from the man from whom he purchased his outfit, writes the Armstrong Mfg. Co., manufacturers of blast hole drills, Waterloo, Iowa.

Instead, he is referred by the manufacturer from whom he purchased, to the manufacturer of the engine, and while this might not prove serious in some cases, we know of a number of instances where the manufacturer who had supplied the engine had gone out of business and repairs could not be obtained, and after long, expensive and vexatious delays the purchaser has been obliged to buy another engine in order to operate his machine.

Another objection is the fact that the manufacturer who is buying his engines on the open market will use one make of engine this year, another make of engine next year and so on, changing from one engine to the other as better prices can be obtained from different manufacturers..

Armstrong engines are built especially for operating Armstrong drilling machines.

This view illustrates the Armstrong Special Gasoline Drilling Engine with fly wheel removed on the governor side in order to show the extreme simplicity of the engine, its durable construction, and our speed changing and controlling lever as it is connected up for operating from the drilling end of the machine.

The lever as shown extends to the quadrant, and by reference to this illustration you will obtain a clear idea and understanding of the engine and its simple and efficient operation. Remember that there is no

other gasoline engine manufactured today that will operate a well drilling machine as satisfactorily and as economically as the Armstrong and remember also that Armstrong engines, like Armstrong drilling machines, are built for service—not to create a market for repairs.

Made Complete in Our Own Factory.

All Armstrong engine are made complete in our own factory. The castings are made in our own foundry and with our complete manufacturing facilities it is possible for us to include in the building of these engines only the best materials.

Each and every part of the Armstrong engine is easily accessible, the complete igniter can be removed from the engine without disturbing the valve or igniter setting or any other parts and all adjustments on the engine can be made independent of and without disturbing any other parts.

Fuel

Armstrong engines are furnished for operating on gasoline, naphtha, distillate or kerosene, and without change operate as well on naphtha as any engine on gasoline.

Give us your specifications and we will furnish complete information and quote prices.

WELL PLEASED WITH RESULTS

The Logansport Stone and Construction Co., Huntington, Ind., who operate a crushing plant at Logansport, Ind., recently purchased a Blast Hole Drill from the Armstrong Mfg. Co., Waterloo, Ia., and they write: "The drill has filled the requirements in every respect and has drilled in excess of the footage guaranteed. Your Mr. J. R. Nash instructed our operator in handling the machine and we are glad to fulfill our part of the contract."

CONCRETE SILOS

A most complete booklet on the subject silos, is issued by the Polk-Genung-Polk Company, Fort Branch, Ind., and carries the title "The Polk System." It covers 48 pages, is freely illustrated from photographs of actual construction, and methods, tables and other valuable information regarding silos. It will be found of value to anyone who is interested in this subject.

CONCRETE BLOCK MAKERS

License Officer Fred Kelly made complaint against five cement block manufacturers of Grand Rapids, Mich., and secured warrants for their arrest on the ground that they are operating without licenses.

Last year the city had some difficulty in securing action from the cement block men and it was very late in the season before they all paid the $10 fee. This year Mr. Kelly declares his repeated requests that they secure their licenses under the ordinance have been met by evasion and in one or two instances the manufacturers have declared they did not know whether they would pay the fee or not. So Kelly decided to have a few arrested.

His complaints were directed against William G. Merkles and Peter Michels, doing business under the name of Michels & Merkles; Frank Ohl; Henry Wolcott, proprietor of the Standard Artificial Stone Company, and Edwin Owen, president of the Battjes Fuel and Building Material Company.

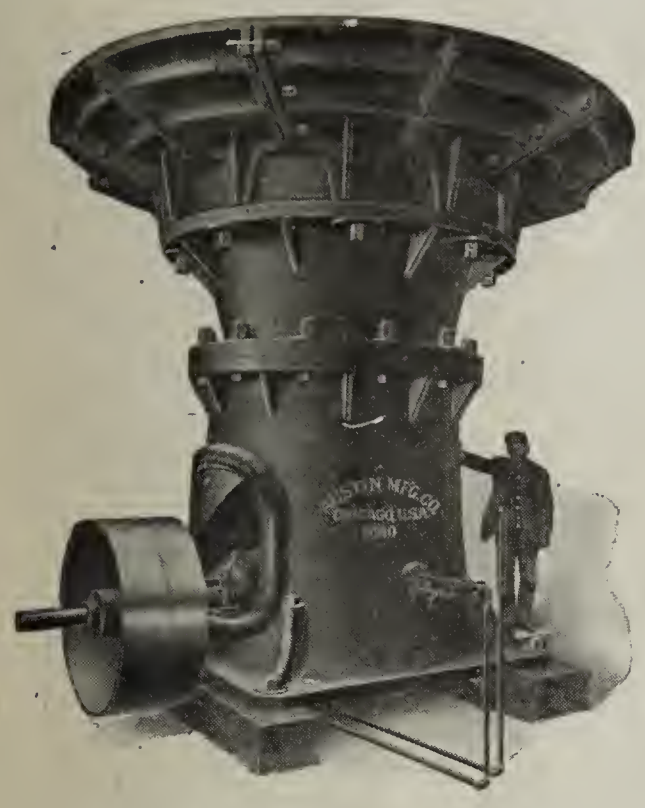
CHAS. A. SCHIEREN CO.

The Chas. A. Schieren Co. of New York, manufacturers of belting, have just issued a catalogue in Spanish for intending purchasers in Spanish America. The catalogue describes in detail the process of manufacturing belting and gives advice how to use it for transmission purposes.

TEN STATES PRODUCE BULK OF PORTLAND CEMENT

The production of Portland cement in 1912 in the United States was 82,438,096 barrels. This production was reported from 24 states, the first ten states, namely Pennsylvania, Indiana, California, New York, Missouri, Illinois, New Jersey, Michigan, Iowa and Kansas given in the order of their importance, reported 69,682,321 barrels, or about 85 per cent of the total. These states ranged in production from 26,441,338 barrels in Pennsylvania, or over 32 per cent, to 3,225,040 barrels in Kansas or about 4 per cent of the total. Indiana, the second largest producing state, reported 9,924,124 barrels, or 12 per cent, and California, the third state, reported 5,974,299 barrels, or over 7 per cent of the total. These first three states reported over one-half of the total production.

Austin Gyratory Crushers



The World's leading Ore and Rock Crusher. Its many superior qualities and mechanical advantages have won the highest reputation amongst Mining Engineers and Quarrymen.

Made in NINE sizes with capacities from 50 to 5000 tons per day. Smaller sizes can be mounted as Portable Plants. Thousands in use.

Plans and specifications furnished for any size of Plant.

Austin Manufacturing Company

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Cement Mill Machinery

requires gears that meet the severe conditions imposed upon them in the Cement Industry.

Nuttall Gears

are used extensively on cement machinery now in operation.

Let us know your requirements

Nuttall - Pittsburgh

The Largest Gear Works in the World

For Complete Detonation of Explosives Use

DU PONT

ELECTRIC FUZES

The Du Pont Electric Fuzes are designed to produce the quick and powerful shock so essential to complete detonation of explosives.

Complete detonation means cheaper blasting. All of the explosive is utilized—none of its force is wasted.

With every bore hole properly charged and detonated with Du Pont Electric Fuzes, increased production may be confidently expected.

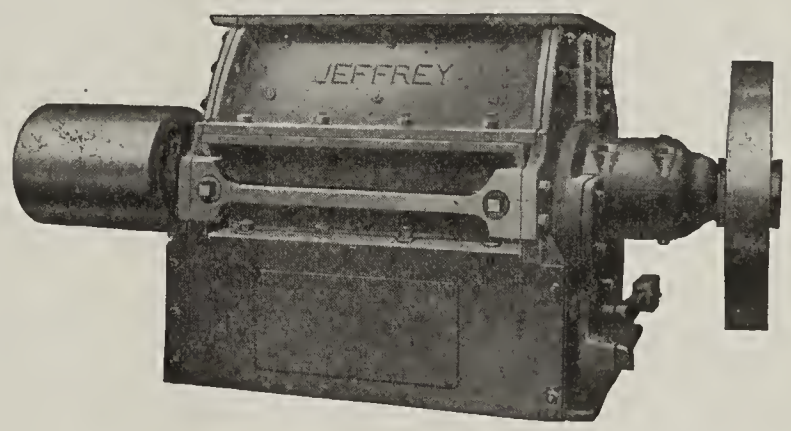
For complete information relating to Du Pont Electric Fuzes, and Blasting Supplies, ask for "Blasting Supplies" Booklet No. 112.

E. I. du Pont de Nemours Powder Co.

WILMINGTON, DELAWARE

Pioneer Powder Makers of America

Established 1802



If you're not satisfied with your Crushing Equipment, install a

Jeffrey Swing Hammer Pulverizer

Here are some of the features that combine to give results unequalled by any other machine on the market.

Manganese Hammers — Drop Bottom Screen Cage
Hard Iron Chilled Liners — Automatic Feeder
Manganese Screen Bars — Self Aligning Bearings

We can furnish additional proofs if you will give us the opportunity.

Write for catalogs and prices.

JEFFREY MFG. CO., Columbus, O.

New York, Boston, Philadelphia — Pittsburgh, Charleston, W. Va., Birmingham — Chicago, Denver, Montreal

Among The Cement Mills

CEMENT DUST IN FACTORIES

Toiling in the whirling, seething dust of cement factories, far from being injurious to health, as the labor lobby claims, is even of actual benefit in some cases, according to Dr. W. G. Downing of Suisun, who was called to testify before the committee on public health and quarantine yesterday, at Sacramento, California. The physician was not alone in his belief, as several workers in the cement factories claimed that such laborers take on weight and improve in health.

The fictional belief that horses may get their teeth coated by cement from nibbling hay covered by the gray dust is refuted by the report of the cement companies' expert.

"Nothing but pyorrhea," was the verdict.

Six companies from various portions of Northern California were represented before the committee to oppose the favorable recommendation of the bill by Senator Bryant, labeled "an act to protect the health of persons employed in the manufacture, packing or handling of Portland cement."

Paul Scharrenberg, one of union labor's representatives here, and a husky-voiced individual who claimed to have acquired bronchial trouble from handling cement and breathing the dust, were on hand to defend the measure, while the Portland cement manufacturers were out in force with physicians, experts, an attorney and workmen to oppose the adoption of the Bryant bill. The act provides for the packing and shipping of cement in sacks with a paper lining and for several other requirements, all of which, according to Scharrenberg, the German government has already made provision for.

On behalf of the cement companies their representatives declared that the imposition of such rules would simply force them to close their doors, as the competition of Japanese companies and of Eastern companies would win out. They also explained that the interior lining of paper would promptly be broken and the dust would fly as thickly as ever.

The chief point made by the labor advocate was that the dust breathed by the sailors, longshoremen and others engaged in loading ships' holds is very injurious to health and that men will not work at it for that reason.

In opposition to this theory the Portland cement makers from all over this part of the state introduced testimony to show that cement dust does not get into the system in quantities sufficient to do any damage, even when the air is absolutely full of it. They and their physicians pointed out that the dust is absolutely sterile and antiseptic, as it is passed through the terrific heat necessary to bring it to the proper stage and this removes all germ life or possibility of infection. Besides, the lime in its makeup is a strong antiseptic.

None of the physicians who were brought here by the cement makers would admit that there was any possible evil effect from breathing the stuff except a little irritation of the mucous membrane in some cases. They branded the theory that it caused tuberculosis as absolutely absurd.

Scharrenberg thereupon offered to bring to bat an equal number of victims of the deadly dust and physicians to tell of its effect on the human system. Partridge, for the cement makers, took a hand in the game, and "raised him 500," offering to produce that number of healthy examples. He later increased this number to 1,000 in case Scharrenberg wanted that many in proof of Portland cement's healthful qualities.

"It's like a summer resort to work in these factories, according to him," sneered the labor lobbyist.

In order that both sides may make another showing and offer more documentary evidence, another hearing on the bill will be held after the second part of the session has begun.

TWENTY TONS OF POWDER TO GO OFF AT ONCE

Forty thousand pounds of blasting powder will be touched off and simultaneously a greater mass of limestone than would balance in weight the Famous & Barr building will be dislodged from the banks of the Missouri River near Fort Bellefontaine, Mo., says the St. Louis Times.

The blast is the third largest ever shot in the United States, the larger ones being that used in the opening of Hell Gate in New York harbor and another at San Francisco.

The blast will be fired for the Union Sand and Material Company of St. Louis for use in the cement plant of the company at Prospect Hill, St. Louis County. It will be done by Samuel Hagy of the E. L. Du Pont de Nemours Powder Company.

The company hopes to obtain 145,000 tons of limestone from the shot, enough to fill 3,000 cars. This will keep the crushers in operation three months and will keep the cement plant working continuously fourteen months.

The greatest secrecy has been observed as to the time for firing the shot, as it was feared that some sightseers might be injured when Mr. Hagy touched the button connecting the batteries with the caps.

None of the men employed on the work will be within 1,500 feet of the explosion when the charge is set off. Sentinels will be put out in all directions to prevent any possibility of injury to sightseers or persons passing in the vicinity.

The cost of the powder used in the blast is $7,000, and should it fail, it will mean a loss of thousands of dollars to the company.

PRODUCTION OF CEMENT WAS 83,000,000 BARRELS

The total production of Portland, natural and puzzolan cement in the United States during 1912, according to an advance statement by Ernest F. Burchard, of the United States geological survey, was 82,351,181 barrels, valued at $67,461,513, as compared with 79,547,958 barrels, valued at $66,705,136, produced in 1911. Of this, all but less than 1,000,000 barrels was Portland cement.

The increase for the year in quantity of Portland cement was 4.98 per cent, and in value, 1.13 per cent. At the end of the year the apparent stock of Portland cement on hand was 7,811,329 barrels, compared with 10,385,789 barrels on hand at the end of 1911, indicating a reduction of more than 2,500,000 barrels in stock.

During the year there were 4,215,533 barrels of cement, mostly Portland, exported, as compared with 3,135,409 barrels for the year preceding. The amount imported was approximately 68,500 barrels, as compared with 164,670 barrels during 1911.

THE NEGLEY PATENTED EXCAVATOR

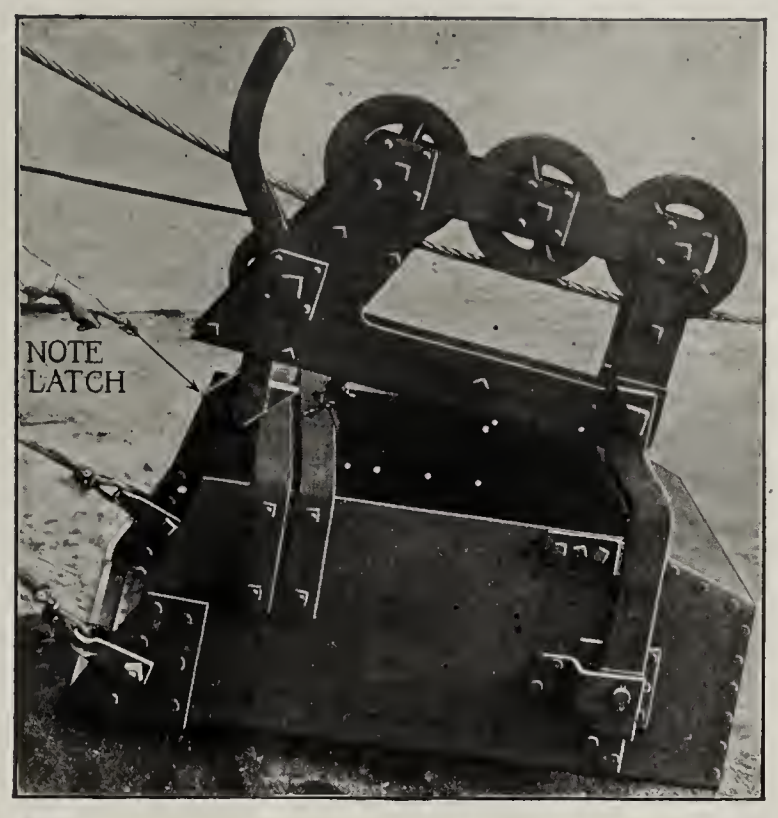
NEGLEY EXCAVATORS

Are up to the very minute.
Do all that others will do.
Do things others can not do.
Have very few wearing parts.
Dump fast or slow, as required.
Have no equal in production.

EXCAVATORS

Dump at either end of cableway.
Have a clearance of 3½ feet.
Dump closer to the mast.
Return to excavation by gravity.
Work where any other will work.
Do not require skilled labor.

BEST FOR SLACK CABLE USE



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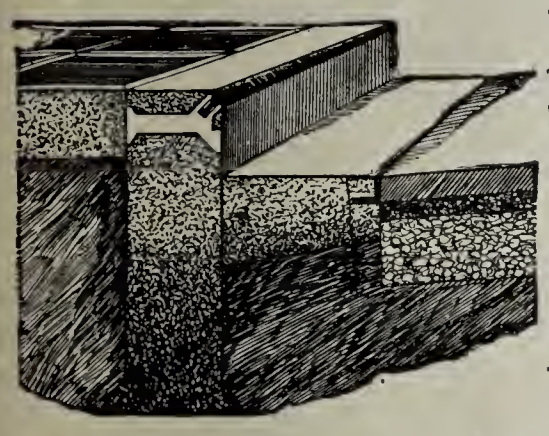
Indianapolis Cable Excavator Company

NEW YORK ST. AND BEAUTY AVE. INDIANAPOLIS, INDIANA

WAINWRIGHT GALVANIZED STEEL CORNER BAR

FOR PROTECTING EDGES OF CONCRETE CURBS, STEPS, COLUMNS, ETC.

IT HAS A RECORD OF FOURTEEN YEARS' USE WITHOUT A FAILURE



"WAINWRIGHT PATENTS" MARCH 9, 1897. NOVEMBER 22, 1898. MAY 5, 1903. MARCH 26, 1900. AUGUST 29, 1907. AUGUST 2, 1910

This bar has been in public use for more than 14 years as the main feature of the

WAINWRIGHT STEEL-BOUND CONCRETE CURB

ABSOLUTELY NON-BREAKABLE

CHEAPER THAN GRANITE

OVER FIVE MILLION FEET

IN USE IN MORE THAN

FOUR HUNDRED CITIES IN THE UNITED STATES

THIS CURB WILL STAND HARDER USE AND LAST TEN TIMES AS LONG AS PLAIN CONCRETE CURBING

METAL PARTS FOR SALE. SEND FOR COPYRIGHTED BOOKLET NO. 4

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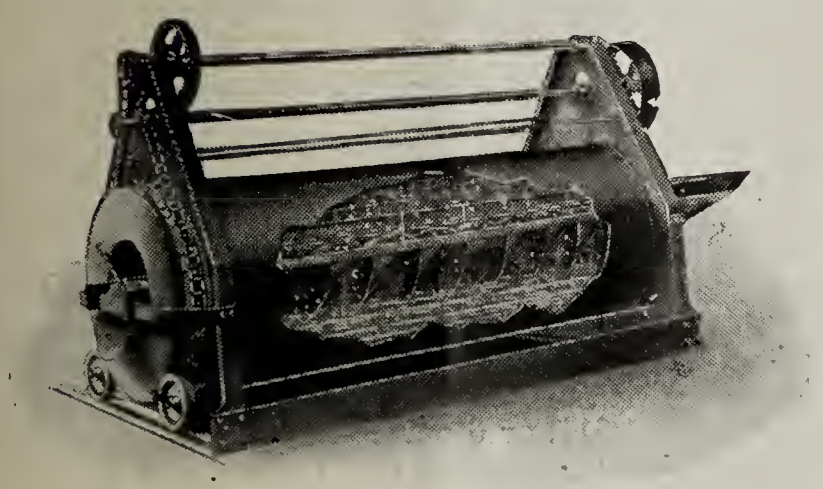

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Stocker Concrete Material Washer Co. HIGHLAND ILLINOIS

Among The Cement Mills

BLAST HOLE DRILLING MACHINE

Armstrong Manufacturing Company, Waterloo, Iowa, manufacturers of the famous Armstrong blast hole drill for quarry operators, has received the following letter, under date of March 20, 1913, from the Fort Dodge Portland Cement Corporation, viz:

"Yours of March 19th at hand and in reply will say that our Armstrong drills are saving us money, everything taken into consideration, over the steam or air tripod drill. In the first place, it is hardly possible to operate a tripod drill on a 26 foot face without shooting in benches, which method has many disadvantages and is very inconvenient.

By using the large diameter holes for deep blasting work, one of your machines will do the work of several air or steam drills. You already, I believe, have about the average cost of our drilling which is something less than 15 cents per foot. We are in the habit of drilling 26 foot holes and the blast from one of these holes will give us an average of about 500 tons, making the drilling cost us a little less than 4/5 of a cent per ton. I think you will find this is considered very cheap.

With reference to your new machine which we have just installed, will say that as yet we have not had an opportunity to try out the machine since your Mr. Mathis left. However, I feel very confident that the new machine will do more work than the old one; it is a better built machine throughout, and especially the walking beam, which we think is a great improvement over the old style beam.

Judging from our experience (since June, 1911) with your machine, we would not hesitate in advising a prospective purchaser that he is getting a much better machine for his money than anything else that we know of on the market today.

You are perhaps already aware that in the past year we have hired other well drillers with other types of machines to assist us in drilling, the best any of them were ever able to make was 8 feet per day, while your man, Mr. Mathis, with the new machine, holds a record of 50 feet in 7 hours and 15 minutes.

The old machine has a record of something like 33 feet per day for a month with all time figured against the machine, moving, delays for repairs, shutdowns, etc."

A DONATION OF CEMENT

Cement manufacturers who have offered to give free of charge one per cent of their annual production of cement for three years for the construction of the ocean to ocean highway are displaying both public spirit and good business judgment. The donation is estimated at $2,500,000. It would be worth that to demonstrate in the most striking way the superiority of cement for permanent highway improvement, says the Knoxville, Tenn., Sentinel. The boards of commerce of Knoxville and Chattanooga might profit from the broad hint conveyed by the news of this donation and see what they can do in our territory. The cement road from Chattanooga to Bristol would greatly stimulate road building in the south and open an unlimited market for cement.

V. H. Kriegshaber, of Atlanta, Ga., has secured contract for furnishing city with cement for the next year at $1.78 3-4 per bbl., with a rebate for return of sacks.

MONARCH PORTLAND CEMENT CO.

A meeting of local stockholders of the Monarch Portland Cement Company was held early yesterday afternoon in the commercial club rooms for the purpose of disposing of bonds, says the Hutchinson, Kans., Gazette.

Now that the price of cement has soared to where a good profit can be realized the company will be reorganized and the fine $2,000,000 plant at Humboldt is soon to be placed in operation.

Many of the largest stockholders in the corporation, now in the hands of a receiver, live in Hutchinson. The plant is on a solvent basis according to large holders who were present at the meeting yesterday, selling the bonds. What little indebtedness there is against the company can easily be cleared, they say. The purpose of selling the bonds is to get working capital with which to start operation.

About two-thirds of the necessary working capital has been raised and most of the remaining third will have to be subscribed by Hutchinson stockholders of the concern.

The price of cement is now $1.30 per barrel, whereas it was fifty cents a barrel when the plant suspended operation.

CEMENT PLANT NO. 5 WILL BE CLOSED DOWN

Plant No. 5 of the Atlas Portland Cement Company at Hannibal, Mo., will be closed in a few days, the shortage of labor necessitating this step. Officials of the plant said today that after endeavoring for several weeks to secure sufficient men with which to operate the big mills, it was found necessary to take this step until laborers can be found. Several plans have been adopted to secure workmen but a full force has not been obtained.

Superintendent Baker said today that the closing of plant No. 5 was for the present, but he could not say for how long, as it was caused by inability to secure labor.

DECLARES USUAL DIVIDEND

The Peerless Portland Cement Company, of Union City, Mich., shipped out 1,950 carloads of cement last year, or a total of 337,000 barrels.

Dr. Lancaster, of Alma, was elected president of the company to succeed the late Ammi W. Wright. Other officers and directors were re-elected. The reports were of a gratifying nature, and the usual dividend has been declared. The company has not more than 10,000 barrels of cement on hand, hardly sufficient to carry it through the usual shut-down period.

PRODUCTION OF NATURAL CEMENT

Natural cement was produced in 1912 in fifteen plants distributed in nine states, according to the United States Geological Survey, there being no change in the situation compared with 1911 except a decrease in production. The output during 1912 amounted to 821,231 barrels, valued at $367,222, compared with 926,091 barrels, valued at $378,533, in 1911, a decrease of 104,860 barrels, or 11.3 per cent, in quantity and of $11,311, or 3 per cent, in value. The average price of natural cement at the mills in 1912 was 44.7 cents a barrel, compared with 40.9 cents in 1911.

The Mere Question of Supremacy

is not the only reason for your using "ATLAS" cement. Its success is based on its achievements. Everything within human power to do, has been done in its manufacture just to give you the confidence you now have in it.

The using of "ATLAS" involves a principle—not a price.

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Cut Gears

We have the largest plant in the West, equipped with the latest improved tools Quick deliveries. low prices and first-class work our motto

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Quality Unexcelled — Always Uniform

Annual Output 7,000,000 Barrels

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Every part of a Wyoming Shovel is made right here at Wyoming—handles of the finest second growth Northern Ash, and blades of the highest grade crucible and open hearth steel. Any one interested in the handling of crushed stone, gravel, concrete, etc., should know that our trade mark on Shovels is a guarantee for wear and service.

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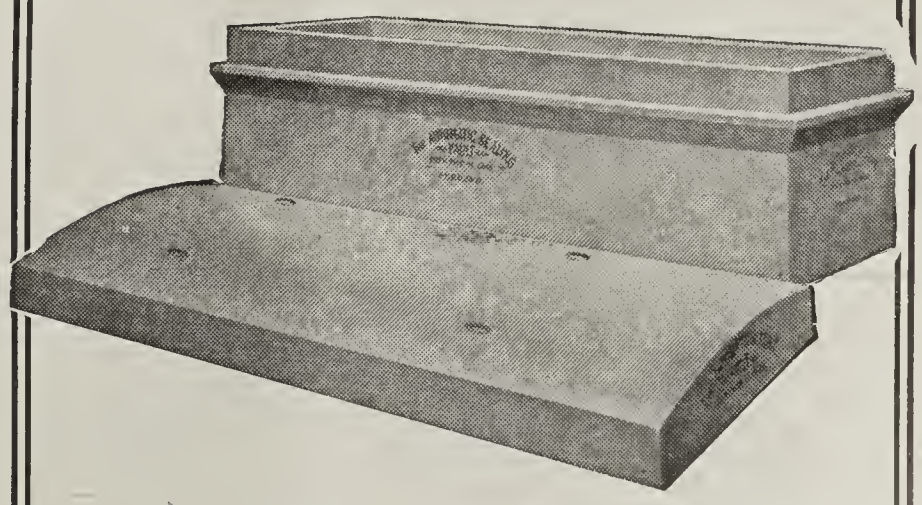

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Create Their Own Market

Wherever the product of our molds is shown, it creates its own demand. You can establish a nice paying business by installing our molds and making Automatic Sealing Vaults at 100% profit. Concrete products manufacturers who have added our vault molds "as a side-line" have found that the "side-line" rapidly outgrew the rest of their business.

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The Automatic Sealing Vault Co.
No. 25 West Canal St., PERU, IND.

TRADE NOTES

Utah Construction Co., Ogden, Utah, have just placed in service a new model 61 Marion shovel, manufactured by the Marion Steam Shovel Company, Marion, Ohio. In the last few months they have purchased five Marion shovels.

Christensen Construction Co., Salt Lake City, Utah, have just placed an order for two additional Vulcan dinkeys, 10x16, 18-ton size. They now have six Vulcans of the 18-ton size.

With the co-operation of J. Z. Miller and W. A. Miller of the Day Ranch Company, near Coleman, Tex., as many as nine silos will be erected by farmers; construction to begin as soon as the material can be placed on the ground. The silos will be of 130-ton capacity, built of monolithic reinforced concrete and erected under the supervision of an experienced and practical concrete man, who will be sent there for the purpose. Those who have entered into contracts for silos are: Thomas Elmore, D. D. Faircloth, Edward Anderson, H. M. Wireman, R. H. Loggins, S. M. Loggins, A. A. Davis, W. L. Davis and J. T. Padyett.

John T. Dyer Quarry Company, Birdsboro, Pa., recently installed another steam shovel of the Marion type, manufactured by the Marion Steam Shovel Co., Marion, Ohio. This makes four Marion shovels now at work at this plant.

CEMENT PLANT EXPANDS

The Northwestern States Portland Cement Company have decided to expand and Saturday additional machinery was ordered so that the output of the plant will be increased 1,000 barrels per day. Heretofore the capacity has been 4,000 barrels and the mill has been crowded to its full capacity. With an output of 5,000 barrels it is believed that the demands can be more easily met.

ENGINE ROOM ACCESSORIES.

Engine accessories of Lunkenheimer manufacture are described in a series of booklets issued by the Lunkenheimer Company, Cincinnati, Ohio. They include valves, water gauges, cylinder lubricators, ground keywork, oil pumps, automatic cylinder cocks, whistles, grease cups, oil cups and other oiling devices.

UNIQUE STONE CRUSHER

The Canadian Pacific Railroad recently purchased an Austin gyratory stone crusher (capacity 50 tons an hour) from Messrs. Mussens, Limited, of Montreal, Que., for use on the north shore of Lake Superior. The crusher, manufactured by the Austin Manufacturing Company, Chicago, together with the entire equipment, excepting the power plant, was furnished and erected by Mussens, Limited, while the power plant, a 4-cylinder 7½x9 "Automatic" heavy duty gasoline engine, manufactured by the Automatic Machine Company, of Bridgeport, Conn., was furnished and installed by the Pyke-Putnam Motor Company of Montreal.

The engine is direct connected to the crusher by a semi-flexible steel coupling, 16 inches in diameter, used for the main drive pulley. The engine is also equipped with a one-way clutch built into the extended engine base, and a throttle-governor maintains a constant speed under various loads. The matter of power equipment was left entirely in Mr. Pyke's hands, and the satisfactory results so far attained seem to warrant his selection of the "Automatic" as a reliable and exceptionally economical power plant, although Mr. Pyke would have installed a semi-Diesel type of oil burning machine had the weight not been so excessive.

The endless belt conveyor presented a most difficult problem as it was necessary that this should readily collapse and fold inside a box car, as no projections could be allowed, the car being often moved from place to place. The crusher is capable of producing hourly, 50 tons of broken stones suitable for ballasting purposes.

It is interesting to note that the Canadian Pacific Railway is the first Canadian road to adopt crushed stones for ballasting purposes and it is probable that the other companies will soon follow suit, as a properly ballasted road is practically free from dust, a pleasure which few travelers have ever realized during the hot summer months, unless they have traveled very recently on some of the foremost American roads.

SAND AND GRAVEL COMPANY BUILDING CONCRETE ROAD

The Rock Island Sand & Gravel Company, Rock Island, Ill., this morning began the construction of a concrete driveway to its new steel hopper which was recently constructed. The approach extends from the hopper between Nineteenth and Twentieth streets on First avenue to the west side of Nineteenth street. The driveway is intended to do away with many of the difficulties encountered during the rainy season.

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Start Your Own Business—One man can make 600 shingles a day with this machine—net profit $8.00. Cement tiles for roofing make the perfect roof. Easy to manufacture—low cost—any color—simple to lay—impervious to moisture, heat or cold—fire proof—handsome—last forever, cost to manufacture, $2.70 per 100 square feet roofing, all material and labor included.

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CEMENT AND ENGINEERING NEWS

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

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JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, AUGUST, 1913

THE MANUFACTURE OF CEMENT TILE

It has long been recognized that the cement tile manufacturer can resist successfully the attacks on the part of the clay tile producer only by leading an active campaign with a view to educating its members to produce nothing but first-class tile. As long as improperly made and insufficiently cured cement tile were placed on the market, it was evident that the clay tile manufacturer could renew his criticism and point out cases in which cement tile failed. This, of course, would hurt the trade of the manufacturer of high-grade cement tile as well as that of the producer of inferior goods.

A standardization of the methods of manufacture and of testing the finished product was, therefore, decided upon as the first and most important step towards keeping up the reputation which manufacturers of well-made cement tile had established.

All parties interested in the outcome of the work have been busily engaged for some time in contributing their share to the final solution of the problem.

The Portland cement manufacturer, who supplies the most important raw material for making cement tile, put his expert to work to investigate the subject thoroughly. University experiment stations were called upon next in order to act as arbitrators and to test both clay tile and cement tile. The result of their efforts was a number of reports on researches covering every phase of the subject, including proposals for standard methods of making, curing and testing cement tile.

At the same time, the manufacturer of cement tile machinery improved the process of making cement tile so much that a reliable cement tile can easily be obtained, at a fair profit, by any one who works honestly and desires his goods to become a credit to the industry.

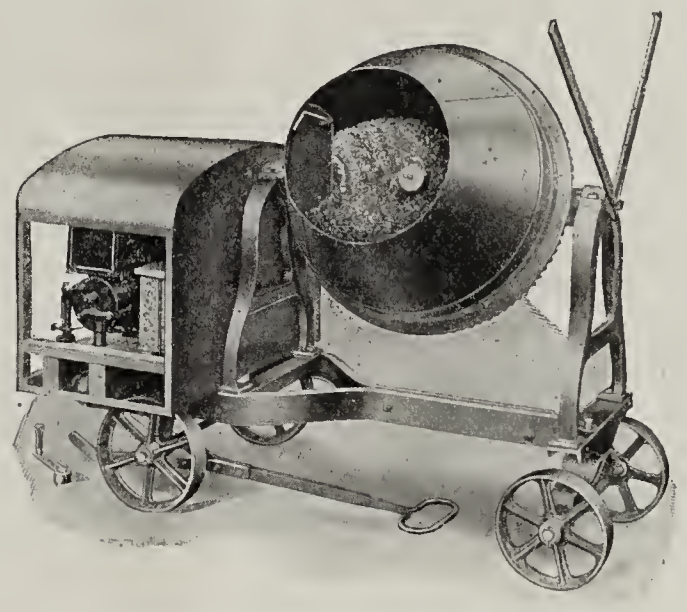
Thus, by combined efforts, the cement tile industry bids well to increase rapidly in the same way as all other branches of the cement industry have grown wonderfully from the time standard rules were laid down as a protection against unfair competition and as a safeguard for the purchaser and consumer of the manufactured article.

CONCRETE MIXERS

Van Duzen, Roys & Co., after an extended experience in the mixer business have learned that the machine which gives the best general satisfaction is the medium sized batch mixer. Not a little and not a big mixer therefore to meet this demand of the contractor, they have brought out the Van Duzen Batch Mixer which has a capacity of 1/6 yard per mix.

This machine is made of iron and steel throughout and the result is a very rigid and compact outfit. The bowl of the drum has rounded surfaces and this drum revolves on steel ball bearings on chilled surfaces. The location of this bearing is such that none of the sand or grit can work into it. The spindle is hermetically sealed so there is no chance of any grit working in on the wearing surfaces.

The drum is operated by a 2½ H. P. Van Duzen



VAN DUZEN BATCH MIXER

gasoline engine. While this mixer can be operated with a 1½ H. P. engine the builders realize the fact that there is always a big advantage in having surplus power.

This mixer is simplicity itself as it is not complicated in any of its parts or mechanism and gives no trouble and anyone can operate it with ease. By the standardization of their output, namely, the one size only the builders have effected manufacturing economies which allow them to quote the very closest possible price. It becomes an economy for the large contractor to install three or four of these mixers as by so doing he can show a much greater working efficiency at a saving in price over one large bulky machine.

Another advantage is, they can concentrate a number of mixers on one job or distribute them to various jobs. The engine is housed in a steel housing, the drum is driven by gears. The wheels run on roller bearings and the machine can be very easily transported from one place to another. They will mail literature to readers of this paper. Address, Van Duzen, Roys & Co., care of Cement & Engineering News, 1117 Schiller Bldg., Chicago.

The New Cement Plant at Spokane, Washington

New Methods of Handling Raw Materials, Reducing Dust Troubles and Gravity Loading

By E. W. Miller*

International Portland Cement Company, organized in 1910 by John S. Irvin and associates, acquired extensive areas of limestone, cement rock and shale in the vicinity of Lakeview, on Lake Pend Oreille, Idaho, and in January, 1912, began the construction of a crushing plant on the lake and a cement manufacturing plant at Trent, a station on the Spokane & International Railway, seven miles east of Spokane. The new factory, with all of its accessories, was completed late last year and was put in operation January 1, 1913. The accompanying illustrations afford a good idea of the magnitude of these works, and the following technical description of the equipment and the processes involved. will be of much interest to cement manufacturers and users.

Quarries and Crushing Plant

The quarry is situated near Lakeview, which is on the shore of Lake Pend Oreille. At this point are located not only the three quarries from which are obtained cement rock, limestone and shale, but the crushing plant as well, which reduces the rock to a size suitable to pass through a three-inch ring. The rock is brought into the crushing plant by two endless cable tramways, in trains of four cars, each car holding four tons. Each train has one grip car, the grip of which is automatically released when the train is about to enter the crusher building, and the train is brought to a stop in the desired position to discharge its load, by flange brakes on each track. The cement rock, which constitutes by far the largest proportion of material to be crushed, is discharged into a number eight Gates crusher, from which it passes to an inclined 24-inch belt conveyor, manufactured by Stephens-Adamson Manufacturing Company, Aurora, Ill., which elevates it and discharges it into a bin with a storage capacity of about 1,500 tons. The limestone and shale are each discharged into number six Gates crushers, which discharge upon a second 24-inch belt conveyor. This conveyor is equipped with a traveling tripper, which discharges the limestone and shale into separate bins, each of which has a capacity of about 250 tons.

Unique Loading Arrangements

The rock is loaded directly from the bins into railroad cars by means of belt conveyors. As the crushing plant is seven miles from Bayview, the terminus of the Spokane International Railroad, the cars are carried on a transfer barge which has a capcity of six forty-ton cars, and in order that there may be as little delay as possible in the loading of these cars, three sets of 30-inch "S-A" belt conveyors have been installed underneath the storage bins, by means of which it is possible to load the entire six cars, or one barge load, in about fifteen minutes.

As many probably know, Lake Pend Oreille is subject to a variation in height amounting to as much as 24 feet, and averaging between 15 and 20 feet each year. In order to be able to load cars at all stages of the lake, three inclined booms, eighty feet long, were installed, each boom being equipped with a 30-inch belt conveyor, which receives the rock from a companion belt conveyor underneath the bins. At the outer end of the booms is a flexible and sectional tube 12 inches in diameter and nearly 0 feet long at the extreme low stage of the lake. As the lake rises, section after section of the tube is removed, by the simple removal of the nuts from two bolts, until, at the high stage, about 20 feet of tube is left. This length is necessary in order that the cars can be loaded evenly without the necessity of shifting the barge.

At Bayview, the cars are drawn off the barge by the S. I. R. R., and taken directly to the plant at Trent. To provide for the fluctuation in the level of the lake, the railroad company has provided an inclined track on which is a movable bridge in the shape of a wedge. This wedge is moved up and down the inclined track according to the stage of the water; and in order to provide for the variation in the draft of the barge, loaded and light, a movable hinged leaf is provided at the outer end of the wedge. The barge is brought up to the outer edge of this leaf, and when in position it is firmly locked to the leaf, so that the movement of the engine and cars off and on the barge cannot break the connection.

We will now follow the train to Trent, where the raw material is changed into the finished product, in one of the most modern mills in the world.

The rock trains are brought into the yard at the plant and weighed on a standard gauge Fairbanks railroad scale. From there they are pushed onto a trestle of three tracks, which is over 400 feet long, and provides storage capacity for over 20,000 tons of raw material. Underneath the trestle are two concrete tunnels, extending the full length of trestle, and each tunnel is equipped with a 20-inch belt conveyor, by means of which the rock and shale are reclaimed and transferred into the mill.

The Elimination of Dust

In the design of this plant, one of the points that was given consideration was the elimination of all dust which might be considered injurious, either to health or the vegetation surrounding the plant. With this object in view a radical departure from the ordinary process of cement manufacture was here instituted.

The greatest percentage of dust from cement plants ordinarily comes from the rock and shale dryers. This is caused by the fact that, owing to the types of grinding machinery in general use, the raw materials must be dried directly after they come from the preliminary crushers. As most of the pieces are of large size, it is necessary to use a comparatively high temperature to dry them, and the common practice is to use angle bars as shelves inside the dryer shell to raise the material and drop it through the hot gases, and the dryer must revolve at a comparatively rapid rate. This gives rise to a great deal of dust, most of which is carried out of the dryer stacks by the strong current of air caused by the high temperature.

In this plant, owing to the use of the Fuller-Lehigh dreadnaught mills, which take a feed up to 1-inch size, the preliminary pulverizers can be operated without the use of screens. It is therefore possible to grind the raw materials to the above size before drying, and by lining the dryers with fire bricks, and turning them at a relatively slow speed, it is possible to drive off all the moisture without making any dust whatever.

*Superintendent, International Portland Cement Company Trent, Washington.

Cement Rock Grinding

For the preliminary grinding of the cement rock a number 8 Krupp ball mill is used. This mill is fitted with a set of sixteen Fuller armor plates with slotted holes 1¼ by 2½ inches in size. The ordinary ball mill is fitted with twelve grinding plates and has two sets of screens outside of them. There are openings between the plates for the return of the oversize from the first set of screens to the interior of the mill for regrinding. This ball mill has no screens outside of the grinding plates, because everything that passes through the 1¼ by 2½-inch holes is small enough to serve as a feed for the Fuller-Lehigh dreadnaught mills. It is therefore unnecessary to have the openings between the plates, so that the sixteen armor plates in the mill fill up its entire circumference. With this arrangement it is also unnecessary to carry such a heavy charge of balls. The ordinary charge of steel balls for number 8 Krupp ball mill is 4,400 pounds, but this mill seldom uses over 2,500 pounds, and only in exceptional cases as high as 3,000 pounds. This means that the horsepower to drive the mill is considerably reduced, and as the absence of screens greatly increases the capacity of the mill, the output per horsepower is remarkable.

The new International Portland Cement Plant at Spokane, Wash. Designed and constructed by the Fuller Engineering Co., Allentown, Pa. The kilns, of which two are at present installed, are 8½ feet in diameter and 160 feet long. These kilns have produced 750 barrels of clinker per day each, and it is believed the capacity will be increased to 900 or 1,000 barrels per day. The Vulcan Iron Works of Wilkes Barre, Pa., furnished the kilns.

The Shale Grinding

For the preliminary grinding of the shale a Jeffrey hammer mill is used. Owing to the nature of the material, it is impossible to use a ball mill. Here, also, owing to the large size feed the finishing mills take, all the screening grids have been removed from the interior of the mill; this mill is also given practically an unlimited capacity.

From the preliminary grinders the raw materials pass to two rotary dryers, 7 feet in diameter and 70 feet long. As stated above, these dryers are lined with fire-brick, and rotate at slow speed.

Storage and Mix at Raw Grind

From the dryers the materials pass in separate elevators to a double row of storage bins, twenty-two in number. These bins have a sufficient capacity for twenty-four hours run, and samples are taken of all the materials as they enter the several bins. The chemist then analyzes these samples and determines from them the exact proportions in which they are to be mixed in order to secure a clinker of any desired composition. In this manner, the chemist has absolute control of the composition of his mix, so that it is practically impossible to have any of the cement turn out wrong.

The different materials are drawn from the bottom of the mixing bins into an electrically operated Larry car in the proportions previously determined by the analysis of the chemist. The materials are all drawn into the same hopper, and the Larry car is then run over another hopper into which the charge is discharged. From here the material is elevated and carried through a mixing conveyor about 30 feet long, through a second conveyor to the bins in the raw grinding mill.

The entire equipment of this mill, with a grinding capacity of from 1,800 to 2,000 barrels per day, consists of three Fuller-Lehigh dreadnaught mills. These mills are the highest development of the present day in grinding machinery, taking, as they do, their feed up to 1 inch in size, and reducing it in one operation to a fineness of 95 per cent through the 100-mesh screen and 85 per cent through the 200-mesh screen, without the use of separate screens, elevators or outside contrivances.

The Fuller-Lehigh Dreadnaught

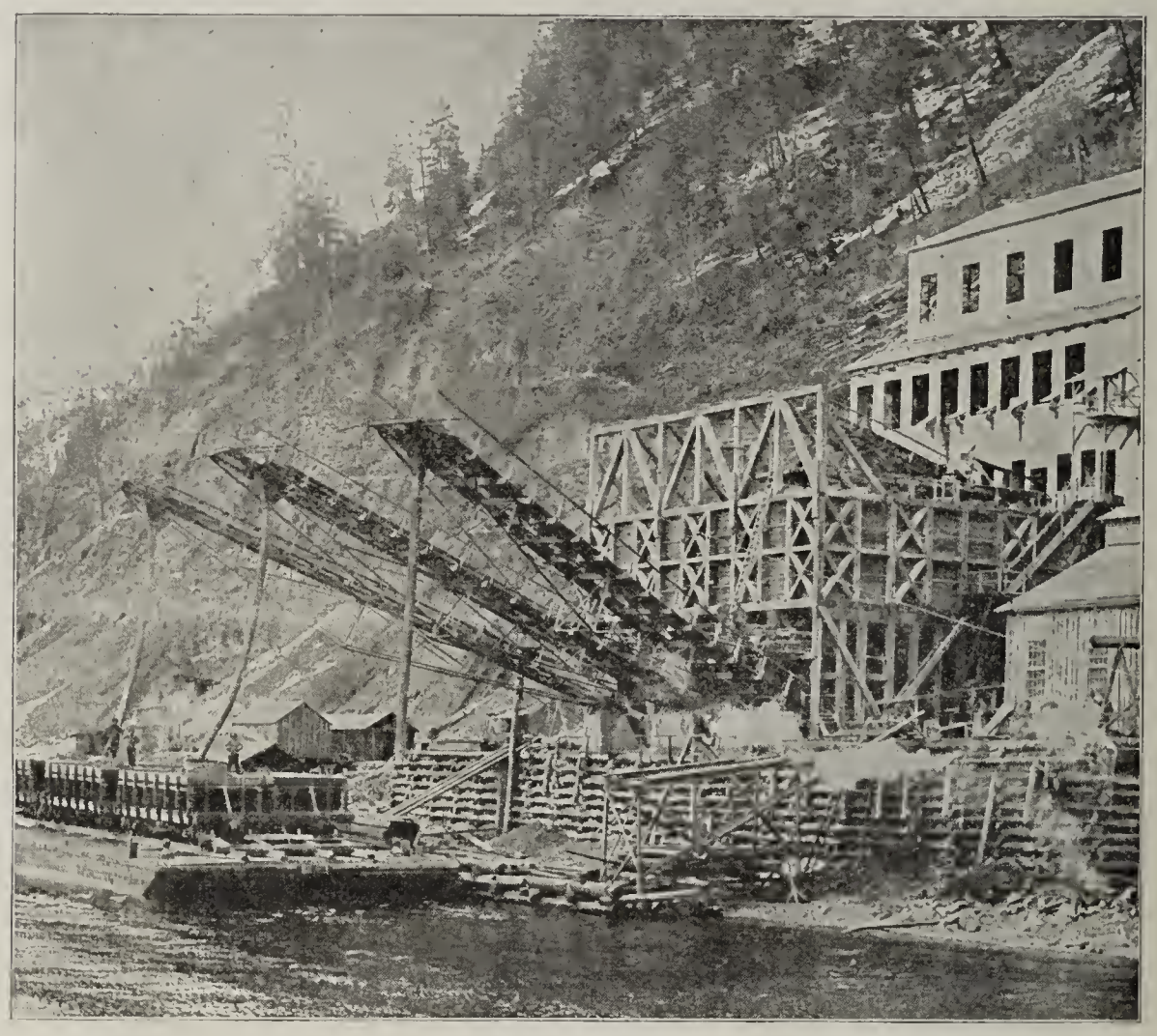
The construction of the Fuller mill is simple. It consists of a vertical shaft on which is fastened a yoke carrying four arms. On these arms are fastened, by

means of steel pins, cast iron pushers. The shaft, with the yoke and pushers attached, revolves inside an extremely heavy cast iron mortar or grinding ring, the inner surface of which is chilled to a depth of about 1½ inches. In the grinding ring, and resting freely between the pushers, are four steel balls, 15 inches in diameter and weighing 576 pounds each. When the shaft revolves these balls are pushed around inside the grinding ring, and are thrown, by centrifugal force, against its vertical sides exerting thereby great pressure against them. The material is fed into the center of the mill at the top, and falls directly down into the grinding ring where it is subjected to the powerful crushing action of the balls, due to their centrifugal force. Owing to the friction of the material against the sides of the grinding ring, the balls are given a rotation around their own axis, in opposite directions to that of the main shaft. The material is therefore subjected to a combined crushing and grinding action exactly similar to the laborarory practice of grinding materials with a pestle and mortar. It is due to this combined crushing and grinding action that the high percentage of impalpable flour is found in all products of the Fuller mill, and this percentage of impalpable flour is higher than that obtained by any other grinding mill.

Above the grinding ring, and fastened to the main shaft, is a double series of eight fan blades. As these fans revolve with the shaft, they create a suction above the material in the grinding ring, thereby lifting all that is finely enough pulverized and throwing it against a screen which surrounds the upper part of the mill. The finely pulverized material then falls down outside the grinding ring into another chamber in which is a large disc provided with another set of fan blades. This disc is also fastened to the main shaft, and its fan blades create a suction outside the screen above mentioned, thus clearing it instantly of all the material which will pass through the screen, and at the same time forcing it out of the mill into the conveyor provided to take it to the bins at the feed end of the kilns.

The 160-Foot Rotating Kilns

The Vulcan kilns, of which two are at present installed, are 8½ feet in diameter and 160 feet long. These kilns have produced 750 barrels of clinker per day each, and it is believed the capacity will be increased to 900 or 1,000 barrels per day. In order to cut down to a minimum, the amount of dust carried out by the kiln gases there has been installed a dust-settling and catching chamber considerably larger than is ordinarily used. The cross-section of the dust chamber is about four times the cross section of the kiln itself, so that the velocity of the gases is reduced correspondingly, and a large percentage of the dust in the gases is dropped at once, owing to the big drop in velocity. To still further clean the gases, three baffle walls are built across the dust chamber, so that the direction of the travel of the gases is changed four times. The result of all this is that the gases, when they finally leave the kiln stack, contain only a small percentage of dust; too small to ever give rise to complaint from this source. In order that the dust which collects in the dust chamber may not pile up and give trouble in the kilns, the bottom of the dust chamber is hoppered, and the dust automatically carried away by a conveyor, to be mixed with the kiln feed and thus returned to the kilns.



Rock Crushing Plant on Lake Pend Oreille, International Portland Cement Company. Belt conveyors loading six 50-ton cars in twenty minutes. The barges are towed across the lake and the cars transferred to the railroad for the journey to the cement plant.

Powdered Coal Firing System

The heating of the kilns is effected by means of powdered coal. The coal is received and stored under a trestle similar to that used for the raw materials.

Under the trestle is a concrete tunnel containing a 20-inch belt conveyor, which reclaims the coal and transfers it to the coal mill. On entering the coal mill, the coal passes through a set of 18x24-inch Lehigh rolls to reduce it all to a size to pass through a three-quarter ring. From here it passes through a Matcham coal-dryer, in which the moisture is reduced to practically nil. It then passes to a bin over two Fuller-Lehigh 42-inch mills, which are identically like the Fuller-Lehigh dreadnaughts except that they are smaller. These mills are guaranteed to pulverize the coal to a fineness of 95 per cent through the 100 mesh screen and eighty-five per cent. through the 200-mesh screen. This extreme fineness is desirable because the finer the coal the less it takes to burn a barrel of clinker; and as the coal is the most expensive of cement making materials, every pound saved by grinding a little finer, means a considerable annual saving in the cost of production.

From the Fuller mills the coal is elevated and carried through a long screw conveyor to the storage bins in front of the kilns. It is drawn out of the bottom of the bins by another screw conveyor which drops it into the blast pipe, where it is mixed with air under 7-ounce pressure, furnished by a high speed Sturtevant fan, and shot into the kiln where it is instantly ignited by the heat of the lining of the kiln.

The burner, as the man who has charge of the operation of the kilns is called, has absolute control of both the kiln and the coal feed. The kiln is operated by a variable speed motor, which has eight speeds between one-quarter and full speed. The coal feed is operated by a Moore and White speeder, by means of which any quantity of coal desired can be sent into the kiln.

The Cement Clinker and Its Control.

From the kiln the clinker drops into a rotary cooler seven feet in diameter and seventy feet long. This cooler is nothing more than a long cylinder with Z-bar shelves, which lift the clinker and drop it through the current of air induced by a stack at its rear end. This stack is provided with a damper to regulate the draft, and if desired, this damper can be closed altogether, in which case the hot air from the cooler will go up into the kiln.

When the clinker reaches the discharge end of the cooler it drops into an automatic weighing scale, to which is attached a continuous counter. An exact record of what each kiln is doing is thus had at all times, and it is easy to determine at once just what effect changes of any kind have on the operation of the kilns.

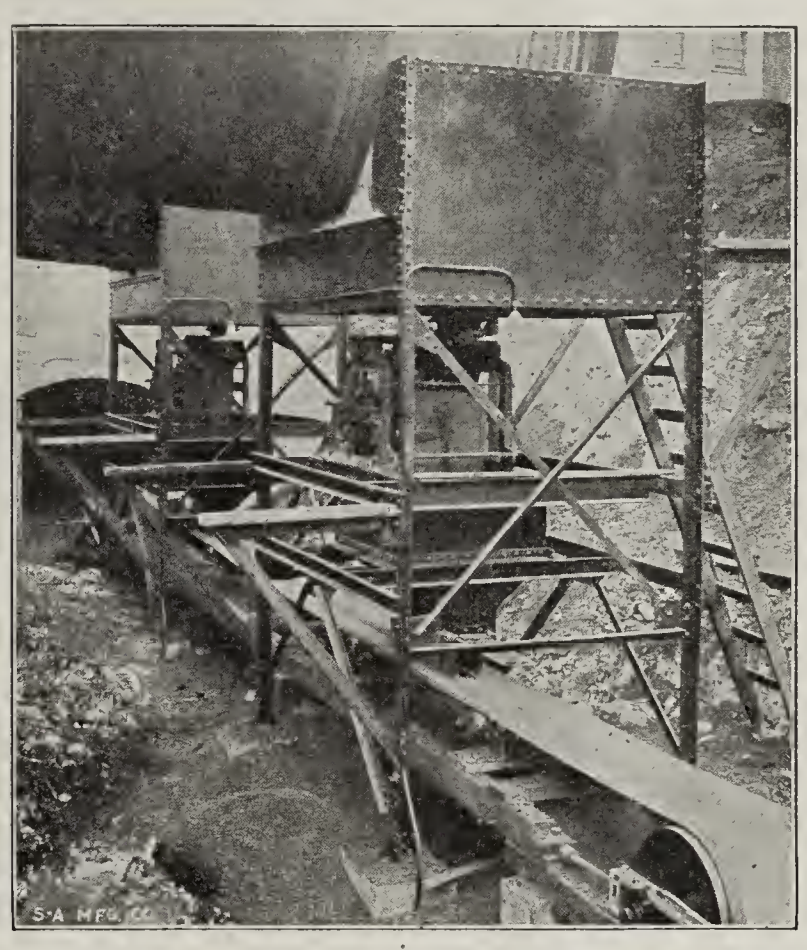
From the weighing scales the clinker is taken by belt conveyor and elevator to another belt conveyor equipped with an automatic tripper, which throws the clinker off the belt and into a storage pile below. Space is provided for the storage of about 50,000 tons of clinker. Under this storage are two concrete tunnels provided with twenty-inch belt conveyors, which reclaim the clinker and transfer it to the clinker grinding mill.

Clinker Grinding Mills.

This mill contains one pair of twenty-four-inch by thirty-six-inch Lehigh rolls, for breaking down any large lumps of clinker so they will pass a one-inch ring. So far, it has been unnecessary to use these rolls, as all of the clinker has been smaller than one-inch in size. The mill contains a large bin for the storage of gypsum, and a hopper scale for the weighing of the clinker and the addition of the gypsum necessary to properly control the setting time of the cement. The only additional machinery in the finishing end, which has a capacity of 2,000 barrels of Portland cement per day, is four Fuller-Lehigh dreadnaught mills, which are guaranteed to have a capacity of 500 barrels each, with a fineness of ninety-five per cent through the 100 mesh sieve and eighty-five per cent through the 200 mesh sieve, and, to date, they have gone above their guarantee, both in capacity and fineness.

From the clinker mill the finished cement is taken to the stock house, which is provided with twenty-one bins, in three rows of seven bins each. There is a concrete tunnel in the center of each, through which runs a twelve-inch screw conveyor. The bins are hoppered to the bottom of the tunnel, so that ninety-five per cent of the cement in each bin will run out without any manual labor.

The cement is packed by means of two Bates packing machines, one on each side of the packing house. There is a railroad track along each side of the packing house, and the packing machines are elevated, so that instead of having to truck the bags away from the



The Discharge End of the Coolers. Conveyor receiving from Automatic Weighers. International Portland Cement Plant.

machines they are shot directly into the cars from the packing machines. This relieves the men who are packing from all manual labor, so that they are able to make the machines work to the limit of their capacity. All the packer has to do is to lift the empty bag and place it on the loading tube of the machine. When it is full, he pulls a lever, and the machine trips the bag off into the chute to the cars.

The motive power at Trent is entirely electrical. The current comes into the transformer house at 60,000 volts, and is there stepped down to 440 volts, at which potential it is used. Every machine in the plant has its individual motor, so that it can be stopped or started at any time without affecting any other machine. The only group drives are where an elevator and conveyor work together, and the power required would be too small for an individual motor drive. In this case the motor drives a short line shaft, from which the separate drives are taken off. This does not affect the flexibility of the plant, because in all cases of grouped drives, it is essential for all members of the same group to run together, so that when it is necessary to stop one of the group the other would be doing no work if it were allowed to run.

The entire plant was designed and constructed by the Fuller Engineering Company, Allentown, Pennsylvania, under supervision of H. W. Wood, general manager and chief engineer of the International Portland Cement Company. Mr. Wood is widely experienced as chemist, construction engineer and operating superintendent in connection with the cement industry. John S. Irvin, president of the company, has operated successfully various cement plants in Kansas and Michigan, and at a number of places in Canada.

NEW WAY OF HANDLING OLD BRIDGES

"Constant dropping wears away stone." A new experiment is being tried in Lewistown, Pa., which will be watched by engineers and workers in concrete with a good deal of interest. The old South Main Street Bridge, a structure of stone, is being widened by concrete arches on each side, increasing the width from 20 to 54 feet. The structure spans the Kishocoquillas creek, a stream named by the Indians.

The interesting part of the experiment will be finding whether the concrete or the stone is the more durable of the two. The concrete from being on the outside of the bridge will of course bear the brunt of the wear and tear, but the fact that it will not be affected as much by changing temperature, and has better shock absorption than stone, leaves the balance of the argument fairly even.

The old bridge was a part of the highway known as the Baltimore Pike and was crossed by all travelers from Bellefonte and north. The new bridge will become part of the highway now under construction by the state through the Lewistown Narrows which are about a mile south of the bridge.

The arches on either side of the old bridge are known by architects and contractors as "the perfect pair" as they are so nearly identical that only a skilled eye can detect the difference. C. E. Flink of Harrisburg, Pa., was the architect who designed the structure, the Ferro Concrete Company of the same place being the contractors. The cement was furnished by The Lewistown Ice & Storage Company, local dealers for "Lehigh" cement.

BRIDGE ON THE BALTIMORE PIKE, LEWISTOWN, PA.

THE NEXT CEMENT SHOW.

The Chicago Cement Show in February 1914, will be featured by the conventions of a number of organizations to be held in conjunction with the exhibition. The plans of the National Association of Cement Users, which will convene in the Auditorium Hotel, February 16-20, have already been announced by President Humphrey. Secretary E. S. Hanson of the Interstate Cement Tile Manufacturers Association is completing arrangements for holding the convention of that organization in Chicago, February 17, 18 and 19, 1914. The National Association of Sand & Gravel Producers, through President F. W. Renwick and the Executive Committee, have expressed their intention of holding their next annual convention during the period of the Chicago Cement Show. Detailed arrangements for the convention are progressing. According to announcements made by Secretary George Wilson-Jones of the Illinois Lumber & Builders' Supply Dealers Association and C. E. Mateer, Executive Secretary, of the Illinois Association of Municipal Contractors, the conventions of both of these Associations will be held in Chicago on dates to be selected falling between February 12 and 21, 1914. Several other organizations are considering the advisability of convening in Chicago during the national Cement Show.

The advantages of holding joint meetings in this way are many. Builders, dealers, engineers, contractors and cement products manufacturers are able to attend the conventions and inspect the exhibits by making but one trip to Chicago. Exhibitors and their salesmen are enabled to make a display which will reach the membership of all the associations.

The Seventh Chicago Cement Show promises to eclipse all the exhibitions of the past. Exhibition space is being reserved rapidly and a wider range of noteworthy and substantial exhibits are in prospect. The recent development of concrete road construction has led to a number of manufacturers of concrete road building equipment to make application for spaces. It is expected that there will be an extensive representation of manufacturers of road machinery and large concrete mixers and concrete handling apparatus.

A Cost and Time Study of Big Blast Hole Drilling

By R. R. Sanderson*

Read Before the National Lime Manufacturers' Association

The big-hole method of quarry blasting is a comparatively new proposition. I believe I am safe in saying that 90 per cent of the quarries now using the big drills have adopted them within the last three years and probably 70 per cent of the 90 per cent within the last eighteen months.

Furthermore, the number of quarries now using big drills compared with the number which might profitably use them is very small. We are thus in what might be termed the pioneer stage of big-hole blasting, and as there are many conflicting opinions and reports in circulation concerning the efficiency of this method of blasting, I am going to give just a brief history of its genesis in order to show how some of these opinions, or rather impressions, have been formed.

To the railroad contractor belongs the honor of first using big hole drills, or as they are now called, blast hole machines of the well-driller type.

The contractor was led to use them for three reasons, first because with them he could put down holes without the necessity of cleaning the dirt from off the rock, as was necessary when tripod drills were used; second, because he could drill large holes which were easily loaded; and, third, because he could put down the holes to any depth desired and thus he could not only blast out a large amount of material at one time, but he could bring it all down to one working level.

In the beginning the contractor had no idea that he could save on his drilling and explosive costs by using big holes. In fact, he thought that there would be a loss on these items, but he figured that these losses would be offset by gains from other sources, such as operating at one level, etc.

The first quarryman to install a big drill was one operating a quarry carrying an extremely high breast and the experimental installation was made in the hopes that the supposedly high drilling and explosive costs would be absorbed by other savings.

The results obtained by this first quarryman were very encouraging and a few other quarrymen working quarries similar to his installed the big drills. Reports from all of these installations were very favorable, and thus the opinion arose that the big drill was the proper thing for working an extremely high breast.

Later on a quarryman working a breast 40 feet in height figured that if he would space the holes far enough back and far enough apart and then load them properly, that he ought to be able, not only to carry all his operations to one level, but that he ought also to be able to reduce his drilling costs enough to offset any extra explosive needed. In these experiments the spacing of the holes was extremely wide and thus the material came out in large blocks. However, as this particular quarry was equipped with big steam shovels and a big crusher, the ultimate results were very satisfactory, and thus the big drills were said to be all right for 40-foot breasts when the plants were equipped with big shovels and big crushers.

As evidence of how firmly this big-crusher and big-shovel idea was implanted in the minds of stone producers, I need only refer to the paper read by Mr. Allen before this association last year, in which he stated that the big drill was welcomed by quarrymen on account of its fitting in with other big quarry machinery.

*Manager Cyclone Drill Co., Orrville, Ohio.

As more and more plants installed big drills, and as different operators began figuring on the proposition, different systems of spacing and loading were evolved, which resulted in getting out the stone in better condition, and finally the opinion began to prevail that perhaps the big drills could be used on breasts much lower than 40 feet. These perhaps opinions were no sooner confirmed than it was discovered that it did not require a mammoth crusher and enormous steam shovels to make a big drill a profitable proposition.

Hardly had this last opinion reached the tooth-cutting age, when a so-called fool quarryman, operating a little hand loading plant with a low quarry breast installed one of the big machines, and in spite of a multitude of predictions to the contrary, he proceeded to materially reduce the per ton cost of producing his rock and at the same time to establish a new usefulness for the big drills.

Now the above in a broad way covers the various steps in the introduction of the big drills and shows some of the reasons why so many conflicting opinions concerning their application exist.

Another thing which hampered the introduction of the big drills by causing mistrust in the minds of the quarrymen, was the naturally-to-be-expected opposition of the manufacturers of the old-standard types of drilling outfits, whose ridicule of the well-drill idea has had a considerable retarding effect. Some of this ridicule was for selfish motives, but by far the largest portion of it, at least such has been my experience, was of the long-eared variety which condemns a thing simply because it is new.

By far, however, the most serious handicap which had to be overcome was the ignorance on the part of the manufacturers of the big drills. This ignorance was not only passive, but it was downright active and resulted in there being placed in a considerable number of quarries many machines which were entirely unsuited for the work. I believe, however, that the quarrymen should shoulder a part of this blame, for they insisted on a so-called good price, and thus the drill manufacturers, at first ignorant of quarry work or quarry conditions, furnished them with little, light, well-drill outfits which, while they would drill a hole, were nevertheless a long time at it.

The showing made by these small outfits was, in a number of cases, so poor as to almost amount to a failure, and as is the case in the introduction of any new machine or method, one failure in the beginning, even though the cause for it is not understood, is very apt to condemn the whole proposition, and requires a large number of successes to counteract its evil effect. In other words, bad news travels fast.

The successful type of big blast-hole machine of the present time is a far different outfit from the light, flimsy affairs which were first used and the records and cost data which will be given further on, refer to results obtained by the use of the modern machine.

The difference between the well drill and the tripod drill is a difference not only of construction, but also of application, and thus involves quite a change in blasting methods.

The blasting operations conducted with tripod drills are carried on with holes of small diameter and comparatively shallow depths; as a rule 20 to 25 feet is

the limit of economical depth. Owing to the small diameter of the holes, it is necessary, in order to get sufficient explosive into the ground, to drill the holes close together, thus making the number of feet of hole per ton of rock moved very high, when compared with the big holes.

The limitation of economical drilling depth with tripod drills requires comparatively shallow shooting and thus it is usually the custom to carry a quarry breast back in benches.

With the big drills the idea is to drill holes of large diameter and space them far apart, thus bringing the number of feet of hole per ton of rock moved, down to the lowest point. Furthermore, as there is no reasonable limit to the depth which can be drilled with the big machines, the holes are drilled the full depth of the quarry, thus bringing all operations down to one level and furnishing at each shot a large quantity of broken stone.

8½ square feet of stone. Figuring on the above basis, the 2¼-inch hole will handle 33.74 square feet and the 5½-inch hole will handle 201.96 square feet, which calculated in linear feet of hole means that it will require 5.99 times as much small hole drilling as large hole drilling.

Now, to put the above in figures so as to make it easily understood, we will assume that in a certain quarry a big machine will drill 60 feet of hole per day. To equal this amount of hole, as far as blasting ability is concerned, the tripod machine will have to drill 5.99 times as much, or 359.4 feet of 2¼-inch hole.

Suppose now, as stated in the beginning, that a tripod machine will drill 1½ times as much hole as the well-drill, then we can expect from each tripod an output of 90 feet per day. Dividing the 359.4, this being the number of tripod-hole feet required to equal the 60 feet of well-drill hole, by the average output of each tripod, which we have figured to be 90 feet, gives

INTERIOR OF THE CRUSHER HOUSE OF FRANCE BROS. CO., WATERVILLE, OHIO, IN WHICH AN AUSTIN NO. 7½ GYRATORY CRUSHER IS FED FROM AUSTIN AUTOMATIC END DUMP CARS.

The advantages which have caused the introduction of the big drills and which are instrumental in making the big outfits successful as cost reducers, are as follows:

First Advantage:

The per ton drilling cost is less, due to the wider spacing. While a tripod machine under conditions which are favorable to it will drill somewhat faster than the big machine, still this difference rarely becomes greater than 2 to 1 and seldom gets as high as 1½ to 1. Figuring the tripod hole as averaging 2¼ inches and the well-drill hole as averaging 5½ inches in diameter, we then have a capacity ratio between the two holes of 3.97 to 23.76. Now, a pretty safe general rule to follow in preliminary testing, in blasting, is that one square inch of drill hole will displace

us 3.99, or practically 4, this being the number of tripod drills required to stand even with the big machine.

Now, as for the cost of operating a big drill, I have rarely found it to be one-half greater than the cost of properly operating a tripod which will show good results on 20 to 25-foot work. In fact, there are plants now operating big machines which are operating them cheaper than they previously operated big tripod outfits.

Supposing, however, that the big drill does cost 1½ times as much to operate as a tripod drill, then the ratio in total cost is as 1½ to 4, or in other words, the tripod drilling costs 2.7 times as much per ton as the big-hole drilling.

To some it may appear that the figures which I give

above are just figures, not being borne out in actual quarry practice, and to such I would say that the above is but an average result and that many plants are doing much better. For instance, the Empire Limestone Company of Buffalo, N. Y., working a 42-foot ledge, now use one well drill and two Rand & Wood air drills, and get out the same amount of material which formerly required twelve of the largest size Rand & Wood drills to handle.

Second Advantage:

The big holes save in explosive. This point, however, is outside the territory of this paper to discuss.

Third Advantage:

The big holes are drilled full depth of the breast and thus they do away with bench men, who are not only expensive as labor, but are also expensive risks as they are not only in danger themselves, but they are a menace to the workmen below. Another expense connected with bench-cleaning (this being an expense which is not often figured), is the loss in productive capacity of the men on the floor of the quarry on account of being on the lookout for the men above. This item ranges all the way from 10 to 20 per cent loss in efficiency up to complete nonproduction of a certain section of the quarry, where on account of the risk involved it is necessary to abandon loading until the bench cleaning operations are over.

Fourth Advantage:

Such a large amount of stone can be shot down at one time that it makes it possible to keep a steady and uniform supply of rock ahead of the men, thus bringing the production of the plant up to the maximum. This item is one which does not, as a rule, receive proper credit, but those quarrymen and especially those quarry foremen, who in an effort to keep their loaders supplied with stone, have jumped from knob to knob and back again with a tripod hung on their shoulder, will readily appreciate the feeling of security which must come to the quarryman who sees a large body of broken stone ahead, and furthermore sees an easy method of replenishing that supply whenever needed.

The removal of the worry of a stone shortage from the foreman's mind gives him more time and inclination to devote his energies to the rest of the plant and if the man is of the proper kind, this will result in increased plant efficiency.

Fifth Advantage:

The shooting is done less often, thus cutting out lost time.

Sixth Advantage:

Big holes are easier to load, and, compared with the tonnage, are cheaper to load, as a big hole can be loaded in about the same time as a small one.

Seventh Advantage:

Big holes are the same size from top to bottom and thus it is possible to load the most explosive where it will do the most good, in the bottom. This results in making a cleaner and better quarry floor.

The seven advantages just named are the primary advantages and should be taken note of when the subject of installing a big machine is being considered. The peculiarities of different plants will, of course, influence the importance of the different advantages and thus the big-hole method should neither be adopted nor condemned, until a full study of all conditions has been made.

The modern big-hole operator takes a broad survey of his proposition and while it is of course expected that the big drill will save on that part of the work with which it is directly charged, namely, drilling, still in making calculations, the careful operator will judge this item of drill saving by final results and final costs.

To get the best results from the big machine each quarry must be studied as a separate unit, and a plan worked out, which, for that particular quarry will produce best ultimate costs. By best ultimate costs I do not mean that it is necessary to make any one charge connected with producing the stone the minimum, but that the final or total cost will be the lowest possible.

To arrive at such a result requires, as stated above, a broad survey of the entire plant and takes into consideration all operations connected with putting the product through the plant.

The items to be considered are:

First—An item which we will call Overhead, which as we will figure it is in each plant a fairly well fixed charge.

Second—Cost of drilling per ton of stone produced, and

Third—Cost of explosive per ton of stone produced.

The first item, Overhead, will be considered as embracing all operating expenses not directly connected with the drilling and explosive costs. In those plants, loading by tonnage, the loading costs need not, unless it is desired, be considered, as they have no effect upon the calculations.

The second item, cost of drilling per ton of stone produced, will be sub-divided into primary drilling and secondary drilling. Primary drilling will cover the big-hole work, and secondary drilling will cover block-holing or any other necessary drilling.

The third item, cost of explosive per ton of rock produced, will be sub-divided into primary explosive and secondary explosive. Primary explosive will embrace that explosive used in the initial or big-hole shots, and secondary explosive will embrace the explosive used in block-holing or mud capping.

The diagram shown herewith will make it easy to note the divisions as I have given them.

Overhead Cost Per Ton:

- Fixed mill or kiln expenses.
- Loading stone by shovel or per day, by hand.
- Labor cost of loading holes.
- Auxiliary labor around quarry.
- Other expenses not directly connected with drilling and explosive costs, and not covered by the above.

Cost of Drilling Per Ton:

- Primary drilling.
- Secondary drilling.

Cost of Explosive Per Ton:

- Primary explosive.
- Secondary explosive.

The three main divisions above are so correlated that you cannot consider one without considering the others, and thus all three will be discussed together.

I would state, however, that it is not my intention to enter the field covered by Mr. Russell, who follows me, and that the blasting will be brought in only as it influences drilling costs.

To reduce the per ton drilling cost to the lowest point, it is very clear that if all other conditions remain the same, the cheapest stone will be that which is produced by the widest spacing.

Thus a 20x20 foot spacing will remove 2.77 times as much material as a 12x12 foot spacing. Now it is very evident that to move a block 20x20 feet will require more explosive, and, it may be a higher grade of explosive, than will be reqired to move a block 12x12 feet. We are thus brought to the point where we must credit the item drilling with its extra saving per ton and debit it with the extra explosive cost, and then swing backward or forward in the spacing until we reach what we might term the peak of economy.

Before settling on this point as final, however, we

have our secondary drilling and secondary explosive charges, also our overhead to consider.

To test our peak point by the yard stick of secondary costs, it is necessary to charge the primary drilling costs for the wide spaced holes with any extra drilling costs or extra explosive costs above the secondary drilling costs and secondary explosive costs when the narrower spacing is used.

Having applied the secondary test, there remains only the item of everhead to consider.

As already stated this item embraces all charges outside of drilling and explosive and, taking a 600-ton plant as an example, remains practically the same regardless of whether 500 or 600 tons of stone per day pass through the plant. Thus a spacing of holes which will produce stone ready to load, at a cost of 4 cents per ton, but which causes the stone to be shot out in such condition that only 300 tons per day can be handled, is more costly than the stone which costs 6 cents per ton to drill and shoot, but which comes out in such shape that 400 tons per day can be loaded. Each quarryman who keeps a close, or even a fairly close, cost record of his work, will be able to figure out about what his overhead runs and will thus be in a position to figure the amounts of per ton overhead on different outputs per day.

To illustrate this point, we will suppose that a plant which produces 400 to 500 tons per day has an overhead of $65.00. This is for a hand loading plant on the tonnage basis. When this plant produces 500 tons per day the overhead cost runs 13 cents per ton; when it produces 400 tons per day the overhead runs 16¼ cents per ton. Thus the 500 tons cost 3¼ cents less per ton to produce than the 400 tons.

Now I realize that some of my listeners will consider that I am getting rather elementary, but the figuring of that item, overhead does not seem to me to receive the consideration which it should, and it is my belief, based on investigations made at a large number of plants, that it is not considered at all by some operators.

Many of the quarrymen operating by the big hole method get the idea that to produce most economical results it is necessary to carry the spacing of holes to the limit. The idea of big initial tonnage seems to occupy their minds to the exclusion of ultimate low per-ton cost of stone. Some of this fault can, I believe, be laid at the door of the advocates of the big machines. In an effort to make a big showing and to demonstrate the low per-ton cost of the initial drilling they recommend a spacing of holes which, while it shows up the drill in a good light as far as the amount of stone shot down is concerned, still is not fair to the quarryman, for the reason that the saving made in drilling is more than offset by losses at other points, due to handling badly prepared material.

A good superintendent soon detects this false economy, but many will consider only the first showing and will thus continue to throw away money on account of the very thing which they consider is showing a nice profit.

I will illustrate this by examples taken from two plants, one a hand loading and the other a shovel loading.

The hand loading plant is a crushed-rock outfit with a quarry carrying a breast 50 feet in height. When their big drill was first installed, the spacing was 15x15, and 250 lbs. of explosive were used in each hole. This method of spacing gave considerable large rock and the spacing was changed to 12x12 and 150 pounds of explosive used in each hole.

The narrower spacing added 46-100 cents per ton to the cost of the primary drilling, but it cut 23-100 cents per ton off the primary explosive.

Under secondary drilling and explosive costs the additional drilling and explosive required by the wide spacing over that required by the narrow spacing amounted to 72-100 cents per ton, and thus the saving by reason of the narrow spacing is 49-100 cents, or practically ½ cent per ton.

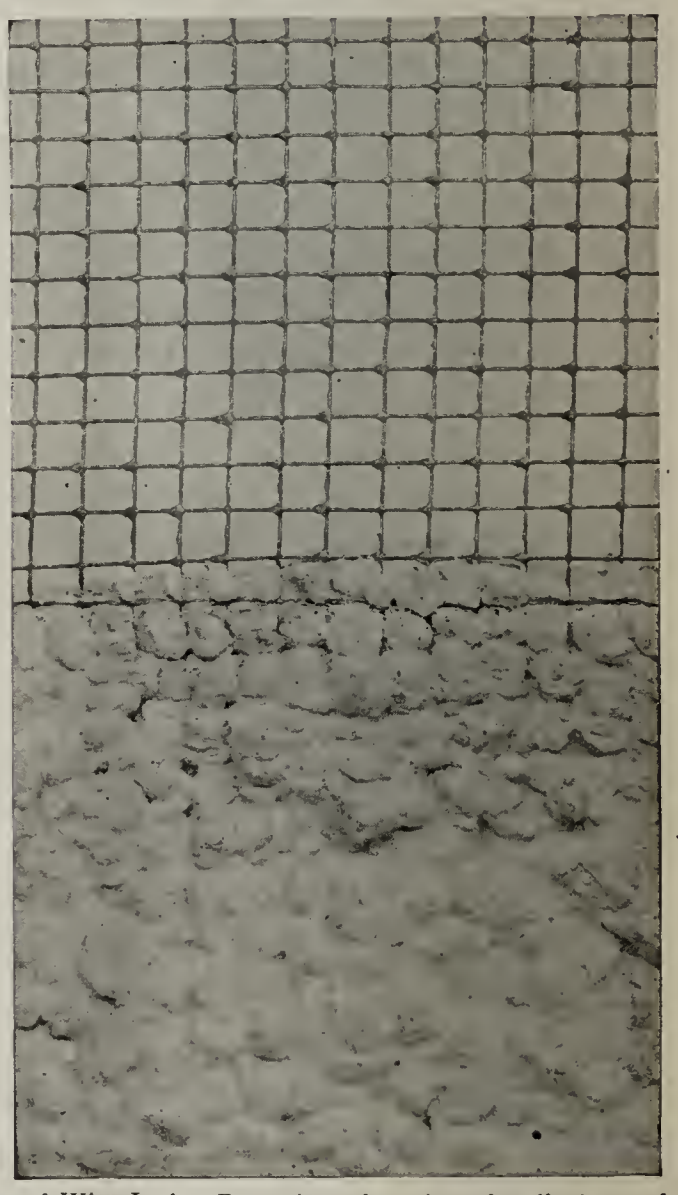
Besides effecting a saving of ½ cent per ton, the narrow spacing enabled the output of the plant to be increased 12 per cent, which increased the saving per ton quite a bit more than 1 cent.

The reason why the secondary cost mounted up so high on the wide spacing on this work was due to doing all secondary drilling by hand and doing a large amount of mud capping. With a good plug drill on the job they could push the spacing back where it belongs and produce stone quite a bit cheaper than they are now doing it.

(To be continued.)

STUCCO HOUSES

Every person, regardless of what his particular vocation may be, is always interested in the home. The architect is interested in the design and construction of dwellings in the every-day practice of his profession; the builder has interest in these matters in connection with his business; but even the man engaged in business or professional activities which are entirely foreign to building or construction is always interested more or less in questions pertaining to the construction of artistic dwellings.



The Key of Wire Lath. Rear view of section of wall plastered on "Clinton" Wire Lath, showing how perfectly this lath is embedded in the body of the plaster.

Recent years have seen a wonderful advance in the development of fireproof, sanitary, and permanent construction as applied to all kinds of buildings, and it is in this development that cement has been a most prominent factor. In utilizing cement as a building

material for residences, two general forms of construction have been developed, namely, the concrete house and the stucco house. By the term stucco is meant the exterior finish of cement or cement-lime plaster, which may be applied to a framework of wood, brick or terra cotta. In this way stucco construction is distinguished from the true concrete house, although both may present similar exterior appearances. The growing popularity of stucco as a finish for residences of all kinds is apparent even to the most casual observer, for houses of this kind are today common occurrences in the city, in the suburbs, and even in the country districts.

Stucco houses, in order to be durable, must be built with great care and must involve the use of the very best materials obtainable. The permanence of stucco construction is dependent absolutely upon a selection of proper materials and a strict adherence to certain essential principles of design and construction. Unless the supporting framework is rigid and well made; unless the materials entering into the construction are of the very best; unless these materials are mixed and applied with unusual care, stucco finish will invariably crack, flake off, become spotted, or deteriorate in some way or another in a comparatively short time. If, on the other hand, the construction is

Residence of Richard Eustis, No. 1 Richmond Place, New Orleans, La. R. Spencer Soulé, New Orleans, Architect. Stucco finish on Clinton No. 21 gauge V-stiffened Wire Lath galvanized after weaving.

Residence of R. Spencer Soulé, No. 8 Everett Place, New Orleans, La. R. Spencer Soulé, New Orleans, Architect. Stucco finish on Clinton No. 21 gauge V-stiffened Wire Lath galvanized after weaving.

good, stucco may be depended upon as an economical and permanent form of construction, thoroughly adaptable to all grades of houses, from the simple bungalow to the most elaborate and costly residence. Being susceptible of almost any desired tint and surface finish, stucco lends itself to a variety of uses and may be developed to almost any degree of artistic embellishment.

Among the various methods of building stucco houses, the most satisfactory form of construction is undoubtedly one in which the supporting framework consists of a good rigid timber construction covered with stucco, supported upon the very best grade of galvanized wire lath. In this form of construction it is important that the studding be well braced and that the boarding or sheathing be securely nailed with all joints properly arranged so that the building may be as stiff and rigid as possible. In order to secure the best results, a good grade of waterproof paper should then be applied to the boards. Nothing but the best grade of paper should be used for this purpose, and it should be carefully lapped and sealed in order to be thoroughly moisture-proof. There should then be applied the very best galvanized wire lath that it is possible to obtain, and this should be tightly stretched and securely fastened to the furring strips in order to prevent sagging of the lath and subsequent cracking of the plaster.

In exterior stucco work the lath is by far the most important material entering into the construction. It is absolutely essential that the lath be of the very best grade: it must be a material which will provide a rigid and unyielding support for the stucco plaster; it must be a material which will not rust away under the action of the elements; and, above all, it must provide a proper key to hold the plaster in place. It is not advisable to use wood lath in work of this kind, as it is cumbersome and does not provide ample support for an exterior plaster subjected to severe climatic conditions. For the purpose of exterior stucco work, the logical and most satisfactory lathing material is a woven wire mesh and this should be of the very best grade of galvanized wire, writes the Clinton Wire Cloth Co., Clinton, Mass. Among the many metal laths upon the market today, Clinton Wire Lath stands out in a class by itself as the very highest grade of commodity made.

A woven mesh made up of the best galvanized wire is the most efficient lathing material known. In the first place, the wires, which are protected with galvanized coating, will not rust. In the second place, a wire will establish a perfect key for the plaster which it is impossible to obtain with any form of punched or expanded metal. A glance at the key side of a wall plastered on wire lath will show the perfect manner in which the plaster surrounds the lath. It is impossible to detect a single strand of wire so perfectly is it embedded in the plaster. To this important fact may be attributed the great durability of wire lath in view of the perfect protection afforded by the plaster and also the great strength of the plastered wall because of the reinforcing action of the wire when so thoroughly bonded with the plaster. The claim that Clinton Wire Lath is durable and everlasting is not a bold unsubstantiated statement. Many actual cases are on record where Clinton Lath has been removed from walls which have been in place for fifty years and the lath has invariably been in just as good condition as the day it was made. A notable instance of this may be cited in the case of the old Fifth Avenue Hotel, New York City, which was torn down a few years ago. From this building Clinton Lath was removed which had been in place for fifty years and the wires revealed absolutely no indication of rust or deterioration of any kind.

In the construction of stucco houses, the stucco finish is an exterior plaster, subjected to the most severe climatic conditions, and it is for this reason that the grade and quality of lathing material is of vital importance to the success of stucco construction.

Clinton Wire Lath may be obtained either plain, japanned or galvanized. It is made from No. 18 to No. 22 gauge wire inclusive with 2½ meshes to the inch and is furnished in rolls 36 inches wide and 100 feet or more in length. For the purpose of exterior stucco work, however, it is advisable to use a lath galvanized after weaving. Galvanizing is a great protection against rust, while the process of galvanizing after weaving solders the intersecting wires and prevents the distortion of the mesh while the lath is being stretched and fastened in place.

In stucco construction of the wooden frame type, after the sheathing has been thoroughly waterproofed, it is customary to provide furring strips, which are ½ inch to ¾ inch thick and 1 inch to 1½ inches in width, placed from 12 inches to 18 inches apart. To these furring strips the wire lath should be securely fastened and tightly stretched. In important work where unusual stiffness is desired, it is advisable to use Clinton V-stiffened Wire Lath. This material is a wire lath provided with V-stiffeners, which are pieces of No. 24 gauge steel, bent into a V shape, securely fastened to the wires and extending across the lath at intervals of about 8 inches. Besides giving additional stiffness these V-stiffeners also afford an offset of about ⅜ of an inch from the supports to which the lath is attached, thus assuring sufficient clearance behind the wire to establish a key for the plaster. This stiffened lath may sometimes be used without furring strips, but in cases where the key should be more than ⅜ of an inch it is advisable to place furring strips about 18 inches apart and arrange the lath so that the V-stiffeners rest upon and across at right angles to the furring strips. Clinton V-stiffened Wire Lath provides an excellent support for heavy stucco construction as it eliminates all danger of bulging or sagging and consequent cracking of the plaster. In applying the plaster the toe or heel of the plasterer's trowel, the standard length of which is 10½ inches, is always on one of the stiffening ribs; thus it is impossible for the plasterer to push back the lath while applying the plaster, afterwards causing it to bulge or sag.

The scratch coat of stucco should be applied very wet in order to secure a perfect key and should be kept thoroughly wet until the second coat is applied in order to obtain a good bond between the successive layers. It is customary to apply a number of coats of stucco so that the total thickness of the finished stucco wall will be from ¾ inch to 1 inch. The total thickness should in no case be less than ¾ inch as it is impossible to make a thinner wall waterproof and thorough waterproofness is absolutely essential to the ultimate appearance of stucco finish. Care should be exercised in selecting the sand to make sure that it is entirely free of organic material as a dirty sand will prevent the proper setting of the cement. Lime or plaster of paris should never be used for exterior construction as it is not durable and will disintegrate under the action of the weather. A small

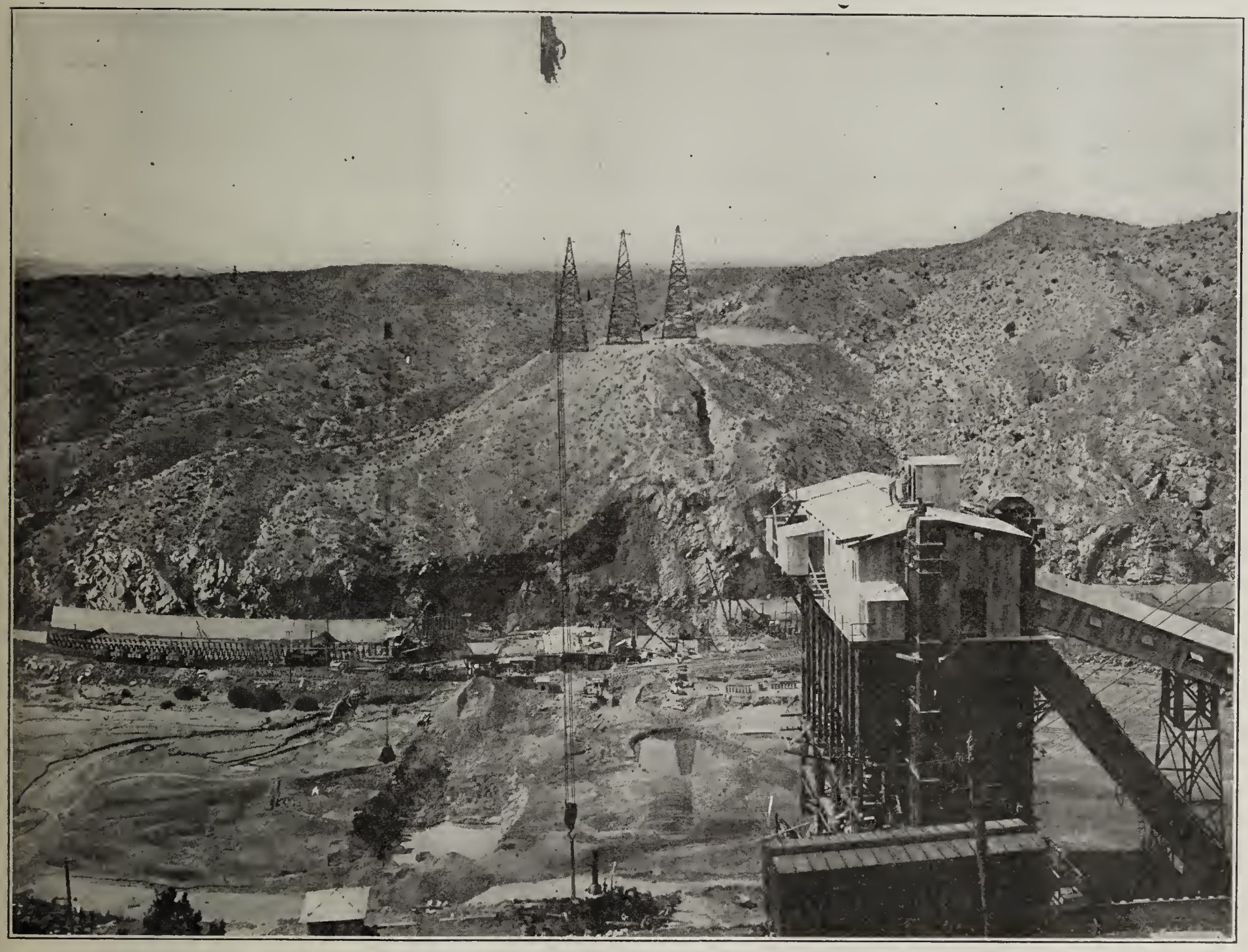
amount, not exceeding 10 per cent, of hydrated lime, however, may be used together with Portland Cement. Stucco plaster should always be a good strong mixture and should never be leaner than three parts of sand to one of Portland Cement.

Various color schemes may be worked out either by adding color mixture to the dry materials of the plaster or by liquid stains applied after the plaster is in place. The latter method is preferable owing to the uncertain effect which the addition of coloring materials may have upon the strength of the mortar. The liquid stains applied to the finished walls may also contain various waterproofing compounds which will make the work impervious. Various degrees of roughness in the surface finish may be developed ranging from the smooth trowel finish to the rough cast or rough suction finish. The rough surfaces, however, are frequently advisable as they do not show fine checks or hair cracks which are liable to occur in work of this kind.

The common idea that stucco houses are frail and unstable is wrong. It must be admitted, however, that a large part of modern stucco construction is very poor. Good stucco construction, on the other hand, in which the best materials are used and the work executed in a proper and careful manner, is durable and lasting and offers an ideal method of building artistic and economical residences of all kinds.

RIO GRANDE PROJECT, NEW MEXICO.

The Federal Government is planning in the Rio Grande Valley, the most elaborate irrigation project in the world. For nearly 150 miles the valley of this stream on both sides is practically to be made over. The simple ditches of the natives which for 300 years or more have served their needs are to be abandoned. Hundreds of miles of new canals skirting the foothills with countless laterals and ditches criss-crossing the valley in all directions, will make a garden a hundred and fifty miles long out of what today is largely a sage brush desert. Four diversion dams across the river at various points will pick up the storage water and turn it into the canal on both sides. From the drops in these canals power is to be developed to lift the water from them, and also from underground sources to lands above the canal lines. An area of 180,000 acres, most of which is today absolutely unproductive will be irrigated in this system. It will provide homes for about 4,000 families on farms, as 40 acres of this land is ample for the support of a family. The one impression and spectacular feature of this big project is the Elephant Butte Dam, upon which construction is now vigorously going forward. This imposing masonry monolith when completed will take a place among the marvels of engineering skill. It marks a distinct step forward in irrigation construction, in daring conception, in massive proportions and in the magnitude of its storage possibilities.



Looking across the center of the Elephant Butte Dam. Its top will be above the roof of the concrete mixing plant in the foreground. The river is now flowing in the sluiceway on the opposite side. Uncle Sam is spending nine million dollars for moisture. It will be the most elaborate irrigation project in the world. For nearly 150 miles the valley of this stream on both sides is practically to be made over. An area of 180,000 acres, most of which is today absolutely unproductive, will be irrigated in this system.

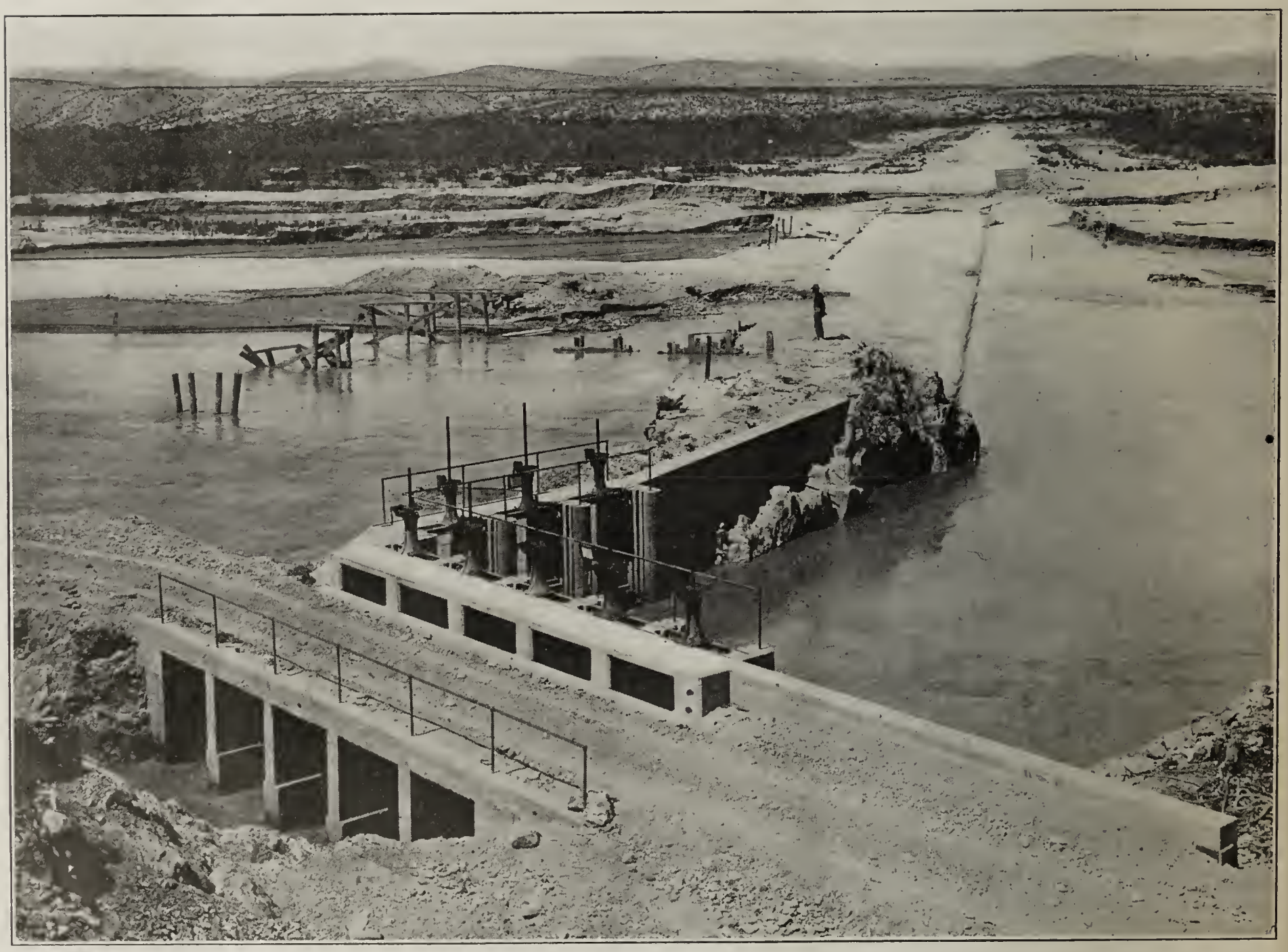
Control of Dust in Portland Cement Manufacture by the Cottrell Precipitation Processes*

By Walter A. Schmidt

The control of the dust arising from the rotary kilns in the manufacture of Portland cement is continually becoming a more serious problem. This is partly the result of the enormous growth of the Portland cement industry, which now demands factories of such magnitude that the large volumes of gases leaving the stacks carry enormous quantities of dust into the atmosphere, but is probably more directly attributable to the present trend of public opinion, which continually demands a more thorough control of fumes and smokes.

The question of the proper relationships which should exist between the factory and the surrounding inhabitants has become a very important social problem. At the present time a large amount of hardship is being caused by improper action on one side or the other, often substantiated by our courts on the ground of mere technicalities. This is a problem which should receive the closest and most thorough study by a competent body in an endeavor to establish such laws as will draw a line of equity between the different parties coming into contact through the development of our modern industries.

Should every smelter, refinery and like industry emit poisonous and noxious fumes from its stacks and all other factories permit smokes and dusts to escape in unrestricted quantities, life in any large industrial center would be unbearable. On the other hand, however, most industrial furnace processes cannot be conducted without the production of large volumes of gases which usually carry from the furnaces volatilized materials and solid particles, these solids being swept along by the heavy rush of the gases. As the factories grow in size and number the damage and "nuisance" caused by the fumes and dusts usually assume most aggravating magnitudes and, after a certain mark is reached, control of the annoying material



Rio Grande Project, New Mexico. Leasbourg Diversion Dam and intake gates of the main Rio Grande Canal. One of four similar ones to be constructed. This one now waters twenty thousand acres. Under sapphire skies, in the brooding silence of the desert, rimmed by inspiring mountains, clothed in richest colors, the valley has slept while all the world passed it by. But the call to awaken has sounded, and the creak of giant cranes and the whistle of engines have disturbed the age long silence. Already the eyes of the homeseekers are turned toward the Southwest, and the valley, as soon as Uncle Sam announces the completion of the irrigation works, will be the mecca of the strong and the industrious from the four corners of the earth.

*Paper presented at the Eighth International Congress of Applied Chemistry.

in the stack gases becomes a necessity. At the outset we are, therefore, confronted with two conflicting factors, first, the one from within the factory, which in many instances makes it utterly impossible to prevent the formation of dusts, fumes and smokes in the manufacturing processes; and, second, the one from without, which makes it equally impossible to permit these materials to escape into the air, due to the damage to the surrounding country. A further complexity arises from the fact that the surrounding country very often demands the maintenance of the factory for its own continued prosperity.

It is readily seen that to permit a problem of such conflicting interests to take its course without thorough study and guidance, is bound to work hardship upon one party or the other, and, of necessity, will result in such unjust proceedings as have at times closed some of our most important industrial establishments or permitted other factories to continue causing damage to the territory surrounding them. A vital question confronts the people today in this regard, in the establishment of a rational relationship between the different parties, taking into consideration the various questions entering into the rapid changes of our present-day industrial development.

The problem of relationships between factory and farmer has become extremely critical in southern California with the cement industry, where the dust arising from the two large factories, the Riverside Portland Cement Company at Riverside, California, and the California Portland Cement Company at Colton, California, settled upon the orange and lemon groves in the vicinity, causing some damage. It would be out of place in this paper to comment upon the actual damage done, as all of the court testimony presented has so far thrown little light upon actual results. Whether the dust really does cause any injury to the trees is a question of minor importance in this particular locality, as the dust makes the groves unsightly and the farmers are convinced that actual damage has been done.

The Riverside Portland Cement Company experimented with numerous methods in an endeavor to control the dust arising from their factory, with little encouraging results, and two years ago the writer undertook the work of applying the Cottrell electrical precipitation processes to this new problem.

The Cottrell processes were invented and developed by Dr. F. G. Cottrell, now of the United States Bureau of Mines, but until recently of the chemistry department of the University of California. These processes were first developed in connection with the problems arising in the manufacture of sulphuric acid by the contact process. After the successful control of these acid mists, the processes were applied to smelter fumes, aiming directly at the control of the sulphuric acid in these gases. The first plant has now been in steady operation for over five years, operating upon the parting flue in the refinery of the Selby Smelter on San Francisco Bay. The processes were later applied to the larger problem of general smelter fume control.

In undertaking the application of the Cottrell processes to the problem of collecting the dust in cement mills, a large number of new factors had to be dealt with, as all work done previously had been conducted upon cool, moist gases either containing large quantities of water vapor, acid fumes or similar materials, all of which gave distinct electrical characteristics to the gases. The primary factors in cement work are dry non-conducting gases, non-conducting dust particles, intense temperatures, large volumes of gases and large quantities of solid material carried by the gases. It is a fair estimate to assume as an average figure that a rotary kiln 100 feet long and seven feet in diameter, oil-fired as on the Pacific coast, has a volume of stack gases of 50,000 cubic feet per minute; the gases above the combustion zone in the stack have a temperature of about 450 degrees C. and carry dust aggregating between four and five tons per day of twenty-four hours.

The plan which was first suggested for handling these gases was to turn all gases from the entire factory into one general flue and conduct them to such a point as would bring the temperature within the region of our past experiences. It was soon found, however, in our first tests, that the dry gases presented entirely different electrical characteristics than were encountered in treating the gases from smelter stacks, and it was later found that the high temperature facilitated the uniformity of the electrical discharge. The plan adopted therefore was to treat the gases at as high a temperature as was permitted by the properties of the structural material used in the treating apparatus. By using ordinary steel, it is quite possible to work at the average temperature of the stack gases, namely, 450 degrees C., provided, however, that the abnormal temporary rises in the temperature in these gases are prevented. The question necessarily arose regarding the possibility of maintaing satisfactory factory operation if we attempted to regulate the stack temperature too closely; extensive tests were undertaken in pyrometric control of the same. Work done during the past year has shown that by installing recording pyrometers in the proper place in the stacks and placing the instruments so that the "burners" can keep close watch upon them, it is an easy matter to regulate the fires in such a way as to give practically a uniform temperature in the stacks.

It was the first plan at the Riverside Portland Cement Company to connect all ten stacks by a common flue which should conduct the gases into a general treating apparatus, but the factory engineers decided that it would be preferable to maintain individual control of the kilns. As the factory design was such as to prevent installing this form of apparatus upon the ground, it was decided to allow the entire stack structure to remain intact and treat the gases after they left the existing stacks. These stacks are eighty feet high and at this level has been constructed a platform upon which the entire apparatus has been placed. In order to test out what effect the apparatus has upon the kiln conditions, we passed the gases through the treater and directly into the air alternately without having the "burners" know the direction of flow of the gases. Sensitive recording radiation pyrometers failed to indicate any effect, either in the temperature of the stack gases or of the burning zone in the kiln.

It might be well here to say a few words regarding the underlying principle of the Cottrell electrical precipitation processes, for those not acquainted with them. The principle consists of bringing the dust-laden gases under the influence of a series of electrodes, some of which maintain a "silent" or "glow" discharge. By virtue of the discharge, the space between the electrodes becomes filled with gaseous ions and the dust particles passing through this space become charged by having these ions impinge upon them, imparting their ionic charges to the particles. The charged particles are then passed through an intense electric field which causes them to migrate in the direction of the field, which in the commercial apparatus is arranged transverse to the direction of

the flow of the gases. The dust particles are by this action drawn out of the gases and deposited upon the electrodes, the gases being permitted to go their way unaffected and emerge from the treating apparatus freed from the solid particles which had been held in suspension.

The distinct advantage which this process has over mechanical processes arises from the fact that the gases themselves play no part in the action in the treater, except as carriers of electricity. In all mechanical processes the entire volume of gas must be acted upon in such a way as to take advantage of the differences in specific gravity between the suspended particles and the gases themselves, or some similar action. In electrical processes the gases are permitted to pass through the apparatus unaffected while the particles themselves are taken hold of individually by the electrical field and acted upon in such a manner as to draw them out of the current of advancing gases and precipitate them upon the collecting electrodes. In order to maintain a definite direction of migration of the dust particles, the electrodes must be given a unidirectional electrostatic charge which, in the commercial apparatus, is generated by rectifying a high tension alternating current. In the commercial apparatus the potential varies under different conditions from 20,000 to 40,000 volts.

The electrode system consists of two forms of electrodes: First, the discharge electrodes, which are made in various forms, depending upon conditions, but are always of a light construction and are so chosen as to maintain a heavy electrical discharge from them; second, the collecting electrodes upon which the solids are precipitated. These are usually of a heavy construction and the form and arrangement are so chosen that no discharge takes place from their surface. The two forms of electrodes are alternated across the apparatus with an electrode spacing of from two to six inches, this distance varying with the conditions to be met. A series of these rows of electrodes is placed in the treater so that the dust particles are brought under the successive action of this series of electrodes. The length of the treater is so chosen as to effect the desired cleaning of the gases. The cross section of the apparatus is made such as to bring a balance between the two forces acting upon the suspended particles, namely, the frictional force tending to carry the solid particles along with the gases and the electrical force tending to draw the suspended particles out of the advancing current of gases.

In the installation at the Riverside Portland Cement Company the treater has a cross section of 12x16 feet, and an over-all length of twenty feet. As stated above, the apparatus is placed upon a platform constructed at a height corresponding to the top of the original stacks, namely, eighty feet above ground. Upon this platform is placed a short stack extension which extends through the roof of the building structure and is supplied with a damper of special design. Upon either side of the stack is placed a complete electrical treater separated from the stack extension by a large louvre damper. By means of these three dampers, the gases can either be conducted through one or the other or both treating chambers or emitted directly into the atmosphere as occasion may warrant. Each stack is equipped with two treaters so as to have an auxiliary apparatus for each kiln. In case one treater should be shut down for repairs, cleaning or the like, the other treater will be able to take care of the gases with moderate efficiency. Under normal conditions the gases are passed through both treaters, insuring a thorough cleaning of the gases. The electrode spacing is here chosen at six inches and there are twenty rows of discharge electrodes in series. The dust is precipitated upon the collecting electrodes, which are cleaned once every three or four hours by being given a mechanical rapping, this action being made automatic to the extent that the operator merely puts an electric motor into operation. The dust falls into hoppers from which it is again conducted into the bins feeding the rotary kilns. Each treater is supplied with a small outlet stack twenty feet high which is sufficient to compensate for the resistance offered to the gases by the treater. As stated above, sensitive pyrometers do not indicate any change of temperature in the kilns or stacks when the gases are permitted to escape directly into the atmosphere or are passed through the treater.

The operating costs of the apparatus are low. A complete treater of the size described consumes approximately seven and a half kilowatt hours. This includes electrical energy for all motors. A 5,000 barrel mill will, therefore, consume approximately 75 kilowatts in an entire installation. The manual labor required consists of one man per shift, of the character of men ordinarily employed to run electrical mill machinery. It is, however, usually advisable to have an extra man on duty. There is no deterioration in the apparatus under steady running and the machinery is subject to exactly the same wear as any other piece of electrical machinery.

CEMENT IN BULK.

The System Magazine for June in its "Players in the Great Game" articles contained a lengthy mention of Gordon Wilson, Assistant Secretary of the Universal Portland Cement Co.

The author of the article on Mr. Wilson touches upon the latter's work in educating cement users to take care of cloth cement sacks, in standardizing the practice among the cement manufacturers in regard to the handling of empty cement sacks and in advocating the shipping of cement, bulk instead of cloth sacks in a large class of concrete work where bulk cement may be used easily and economically.

The article states that "Conservative Estimates indicate that the United States can save one million dollars a year by the use of bulk cement when its possibilities are generally known."

Considerable progress has been made in the use of Universal Portland cement—in bulk—in the last few weeks. The Chicago, Milwaukee & St. Paul Ry., is finding it to be not only a decided convenience but an actual saving of from $10.00 to $12.60 per car of cement, on their track elevation work at their Chicago terminal.

It is commonly found to be difficult to train a gang of laborers who have reached a point of comparative efficiency in handling a given material, away from a method which has been standardized by many years use to a new method of handling which those in charge believe to be worthy of a trial. This was found true in the case of the laborers handling bulk cement but after a few days the work went even more smoothly than before and the grumbling noticeable at first ceased entirely. It was but little time before the work was running smoothly. This is conclusive proof that the initial difficulty with bulk cement was simply due to the unfamiliarity of the men with the new method.

Bulk cement must be considered as an important development in concrete construction. A shipment was successfully made last week from the Buffington Plant of the Universal Portland Cement Co., for use in the Shoreham Shops of the Soo Line at Minneapolis.

The car was received in excellent condition and more will follow.

The Illinois Improvement & Ballast Co., of Chicago is now using four cars of Universal Portland Cement in bulk per day on railroad work. The Nash-Dowdall Co., of Chicago is using one car per day in making cement sewer pipe. The Great Lakes Dredge & Dock Co., of Chicago are using considerable quantities of Universal Portland cement in bulk on dock construction.

The decided convenience and efficiency following the use of bulk cement indicates that this change in the method of handling cement is meeting with popular approval and will have a widely increasing use this season.

A GROWING SAND CONCERN.

The Superior Sand and Gravel Company, which has opened offices at 726-730 Dime Bank Building, Detroit, affords an excellent illustration of the opportunities presented to the energetic young business men of Detroit by the phenomenal growth of the city. This company, only in its third year, found its business assuming such proportions that downtown offices became an absolute necessity. Accordingly a commodious, well-lighted and in every way pleasant suite was selected in the new Dime Bank Building. There the friends and customers of the company will be welcomed.

The Superior Sand and Gravel Company is wholesalers of lake sand and gravel, pit sand and gravel, pebbles and screened sand. While its field is primarily Detroit, the company's operations are not necessarily restricted thereto, recent sales having included a number of shipments to Saginaw, Bay City and other Michigan cities.

Besides the opening of the downtown offices, the company has responded to the demands of its growing trade this spring by the purchase of an additional sand carrying vessel, the Frank C. Osborn. This acquisition now gives the firm two of the largest sand and gravel carrying vessels on the great lakes. Each will hold about 800 yards of lake sand and gravel. Ample dockage facilities have been provided at Delray and Fairview. Pit gravel is obtained from pits at Utica and Yates, Michigan.

The particular business of the company being to supply contractors and dealers in building supplies with sand and gravel, the company's yards being so situated in Delray, Fairview and Highland Park as to be of easy access from every part of Detroit.

The Superior Sand and Gravel Company is capitalized at $200,000. Its officers are as follows: President, A. H. Green, Jr.; Vice-President, E. H. Bingham; Secretary and Treasurer, R. E. Clapp.

While the busy season in the sand and gravel business is not until midsummer, the indications are already very marked that the volume of this year's sales will break all records. Building operations, the barometer of a community's progress, continue at an unprecedented scale throughout Detroit and vicinity.

COAL POCKETS OF THE CLEVELAND AND PITTSBURG COAL COMPANY

CONCRETE COAL POCKETS AT CLEVELAND

Concrete construction was employed in the new Coal Pockets that have just been completed in Cleveland for the Cleveland and Pittsburgh Coal Company. The bins are 150 feet long, 34 feet wide and 43 feet high, and contain 16 pockets each, having a capacity of 155 tons of coal, the total capacity of the bins being about 2500 tons.

The work was done by the Pittsburg Engineering Construction Company. An interesting feature of the work was the manner in which the concrete was handled, the entire job being poured from one set-up by means of a movable chute to which the concrete was conveyed by a skip hoist. This method of placing concrete not only saved time but, as the pouring was continuous, the work was made absolutely monolithic.

Independence Boulevard Bridge, B. & O. C. T. R. R.

By A. M. Wolf

The B. & O. Ry. is at the present time carrying out, in part, its program for track elevation of its Chicago terminal property, the B. & O. Chicago Terminal R. R. on the west side of Chicago. This work embraces many steel bridges protected by concrete over streets crossed by the tracks, which are used by several other roads having trackage rights on the B. & O. C. T. R. R. The largest and most elaborate of these structures is the bridge over Independence Boulevard, between West Taylor and Fillmore streets. This bridge, which spans one of the finest boulevards of the West Chicago Park system, was designed and executed with the idea in mind that it should add to, rather than detract from, the beauty of this boulevard. The adopted design, an ideal one for the location, is a steel structure, encased in concrete so as to give the appearance of a masonry structure of comparatively flat arches with massive but simple and artistic treatment of portals. The design is in accordance with an ordinance passed in August, 1911, by the West Chicago Park Commissioners.

ROADWAY SPAN, INDEPENDENCE BOULEVARD BRIDGE
(Courtesy Railway Engineering & Maintenance Way.)

General Location.—The bridge, a four track, nine span structure, located on tangent, crossing the boulevard at an angle of 90 degrees 33 feet with the center line, is 42 feet wide center to center of fascia girders and 250 feet 10 inches long between abutment faces. The distance between street lines is 250 feet, the face of abutments being 5 inches back of street line. The bridge spans a wide sidewalk and depressed roadway at each end, and a wide parkway between roadways.

Boulevard Subway.—The dimensions, grades and details of subway as given in the following are in exact accordance with the ordinance.

The east walk, 24 feet wide between curb and abutment, has a drop of about 11 inches from abutment to curb. The west walk is 31 feet wide and at same elevation as east walk and has a 11 inch pitch toward the curb. The walks are of cement construction, 5 inches thick, being 8 feet wide on approaches and in subway extend from abutment to curb.

The east driveway, 32 feet wide between curbs, is depressed 2 feet below level of walk at the curb, in order to give 13 feet clearance at the crown of roadway. The west driveway is exactly similar in all respects to the one on the east. The roadways are 32 feet wide only in the block between Fillmore and Taylor streets, beyond these points they are 40 feet wide, center line coinciding with center line of subway drive.

The roadways will be paved with asphalt on a Portland cement concrete foundation 6 inches thick. The curbs are of granite concrete 8 inches thick and 24 inches deep where less than 12 inches of curb shows above gutter. When more than 12 inches of curb shows above the gutter, the curb is 12 inches thick at top and 14 inches at bottom, and 5 feet deep.

At the top and foot of slopes of approaches the change in grade of pavements is made to conform to a vertical curve which is tangent to intersecting grades at points 20 feet from their intersection.

The parkway, 131 feet wide, covered by fire spans of nearly identical dimensions, is crowned 2 feet, 6 inches from curbs to center line, the clearance at this latter point being 8 feet, 6 inches. The parkway under the bridge will be covered with 6 inches of crushed limestone bonded with screenings.

All cement walk curbing, paving, electric conduit and sewer work was done by the railroad company

according to standard specifications of the West Chicago Park Commissioners.

Ordinance Relating to Bridge Proper

"The tracks shall be carried across the boulevard on steel bridges of nine spans. Rows of columns supporting said bridge shall be placed parallel with * * * west line of boulevard.

"The width of superstructure shall be sufficient for four elevated railroad tracks, but not to exceed 56 feet.

"The steel work shall be painted a light color selected by the Engineer of the West Chicago Park Commissioners and shall be repainted whenever required to present a neat appearance.

"The superstructure concrete portals and abutments and all walks within the right of way lines of the B. & O. C. T. R. R. Co. across Independence boulevard, shall be forever maintained and kept in good condition by the R. R. Co.

"The girders and masonry of the north and south portals of the subway shall be ornamented and constructed according to designs submitted by the Commission.

"The floor of the superstructure shall be so constructed as to prevent water, dirt, oil or other substance from dropping upon the subway beneath.

"The retaining walls and abutments shall be built of concrete and shall be finished smooth and show no marks of the form. The retaining walls and abutments shall be constructed along the right-of-way lines east and west of the boulevard a sufficient distance and of sufficient height to prevent the loose materials from washing or falling upon the sidewalks."

Abutments

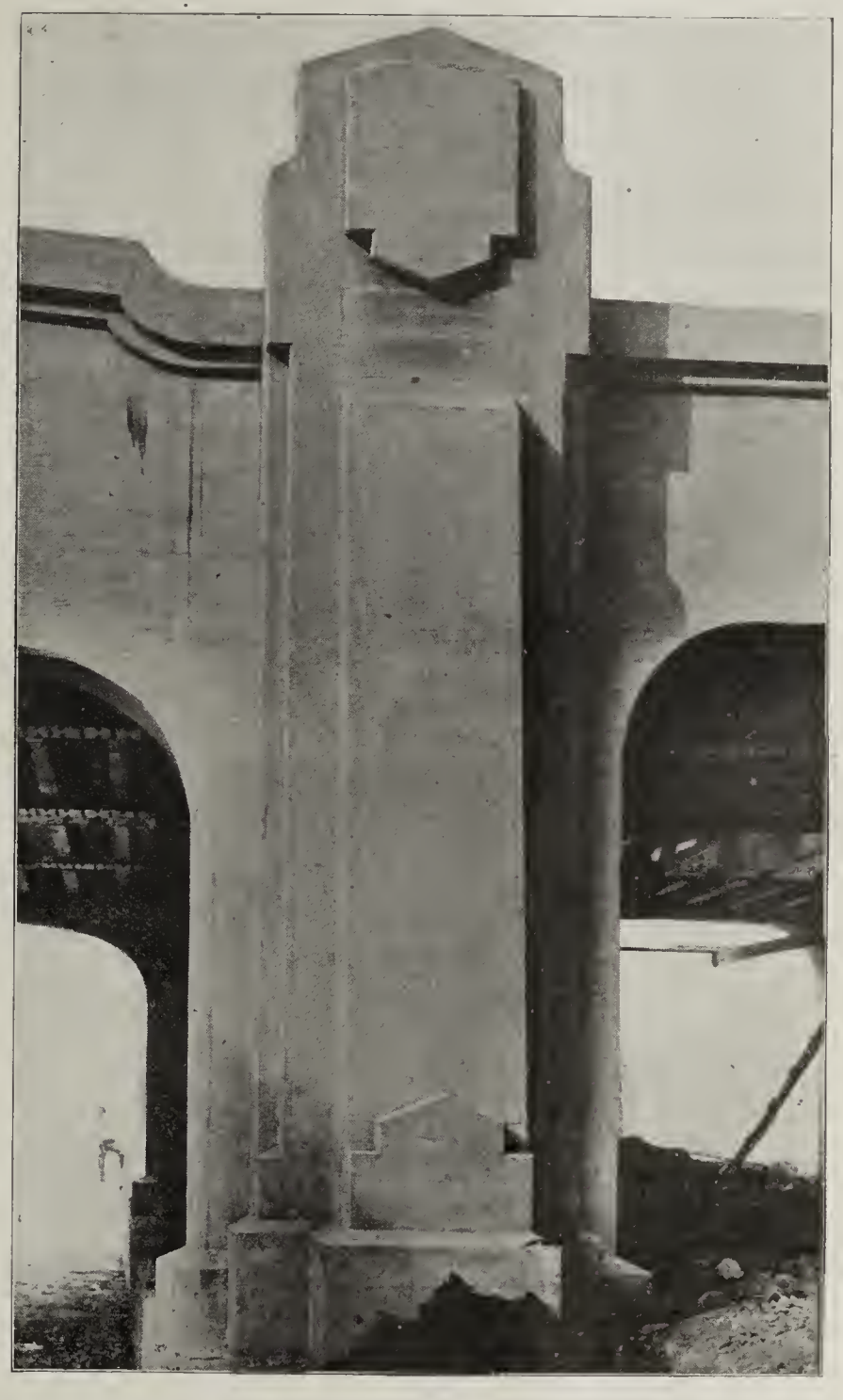
The abutments are of concrete of a 1:3:5 mixture except the bridge seats which are a 1:2:4 mixture. The faces of abutments are vertical and the coping at the bridge seat is omitted; this is a departure from the standard practice of the road, the abutments being originally designed with batter and coping but changed to conform to the architectural design of portals. The bridge seat is 4 feet, 5¾ inches below the base of rail. The backs of abutments are battered, the width at the top of footing being 0.45 of height above the footing. At the north end of each abutment is a straight wing wall with vertical face, and battered back and top slope of 1½ to 1. Wing walls are reinforced with ¾-inch round bars 12-inch centers both ways, near face and back. At the south side the abutments join with retaining walls on the right of way line parallel with center line of tracks. The top width of wall is 18 inches and the face has a batter of 7 inches. The abutments were to have been placed with coping and base of wall at street line, but in order to carry out the architectural design, the vertical faces of abutments were set back 5 inches from street line.

Structural Steel Design

The bridge consists of 9 spans of five longitudinal plate girders each, spaced 13 feet centers transversely, carried on steel columns of a built-up I section. The two roadway spans are 35 feet center to center of columns, the intermediate spans about 25 feet, 7¼ inches, the east end span 24 feet, 6 inches and the west end span 31 feet, 6 inches, center to center bearing. The concrete track floor is carried by 15 inch 42-lb. I-beams placed transversely between girders.

All plate girders are 3 feet 9½ inches back to back of angles, the necessary strength being obtained by varying flange and web sections for the various spans. The long span girders "A" over the roadway are 35 feet center to center of columns and are composed of a web plate 45 inches by ¾ inch and flanges of two 8 inches by 8 inches by ⅝ inch angles, with three 18 inches by ½ inches covers, one full length, one 25 feet long and one 19 feet long. The fascia girders "B" for the 35-foot span have a 45 inch by ½ inch web, with a flange section composed of two 6 inches by 6 inches by ⅝ inch angles and a 16 inches by ⅝ inch cover plate the full length of girders. The other girders are of shorter spans with correspondingly lighter flange and web sections.

The roadway girders are carried by steel columns "W" built up of four angles 3½ inches by 3½ inches by ½ inch riveted to a 12 inches by ½ inch web plate, with 12 inches, 35-lb. channel riveted across the outstanding legs of the flange angles; these columns have the



ORNAMENTAL DETAILS OF BUTTRESSED COLUMN, INDEPENDENCE BOULEVARD BRIDGE

largest sectional areas, the other columns "X" and "Y" being of similar section, but of lighter weight. Base plates for columns "W," "X" and "Y" are 30 inches by 32 inches.

At every third bent a special column is used to provide for expansion connections. These columns or towers "T," as they are called, are composed of two built-up I sections, 18-inch centers, latticed together across the backs of angles. The I sections are composed of a 15-inch by ½-inch web with four angles 4 inches by 4 inches by 7-16 inches riveted thereto. The base plates for these towers are 38 inches by 30

inches. At these towers one span is fixed and the end of the other has an expansion connection. Two 4-inch C. I. downspouts for drainage are placed on each side of these expansion joints between girders.

The base of all columns rest on granite blocks 3 feet square and 2 feet deep, resting on concrete footings. The tops of columns are connected by a transverse latticed strut of four 3½-inch by 3½-inch by ⅜-inch angles connected by a single lacing of angles at sides and battens at top and bottom.

The 15-inch by 42-pound I-beams used as floor beams are spaced 1 foot 9 inches centers longitudinally between girders. The connections with the girders are made very close to the bottom flanges of the girders as shown in the sections. The floor beams at each end of the girders and the one at the center are framed to the girders with a bracket connection composed of a web and two angles, to brace the girders laterally.

The bridge was designed for Cooper's E-50 live load with 50 per cent impact, according to the B. & O. R. R. specifications of 1904. All steel in contact with concrete was unpainted. All other steel is to be given a coat of paint of light color satisfactory to Park Commissioners.

Concrete Bridge Floor

Upon the floor beams is placed a reinforced concrete floor slab 8 inches thick at the center line of tracks at middle of roadway spans and the center span. From these points the slab slopes 1 inch toward downspouts at expansion points and toward ends of bridge where the thickness is 7 inches. The concrete floor is carried up around the girders to top flange as a protection to steel, thus forming a trough section for each track. The slab also slopes transversely from the center line of track to a point near the longitudinal girder where the thickness is 7 inches.

The concrete slab is of 1:2:4 mixture, reinforced with ¾-inch round corrugated bars spaced 8-inch centers transversely. The top of slab is waterproofed by the membrane method. The concrete was mopped with hot asphalt and then a layer of tar or asphalt paper laid thereon and top coated with asphalt. Upon this was placed a 3-inch layer of concrete composed of one part cement and six parts of crushed limestone varying from dust to ½-inch stone. Six inches of crushed stone ballast is used under ties, making the base of rail about 1 foot below the tops of concrete on fascia girders.

Concrete Portals and Ornamentation

General.—The portals of this subway are of concrete so placed as to mask the steel girders and give the structure the appearance of a series of nine arches of very small rise, in fact very nearly flat, with fillets of short radius at columns or piers.

Roadway Spans.—The roadway arches are the largest and very properly the most ornate. The main portion of columns or apparent piers of roadway arches project about 16 inches beyond face of arch with sloping buttresses projecting about 3 feet beyond the main portion. The main portions of these buttressed columns are carried up so as to be higher than top of arch. At the top of columns a medallion of concrete projects 3 inches beyond the face. The architect's elevation of sidewalk, roadway and parkway arches and section B-B show the details of these columns. The main portions of column are reinforced with ¾-inch round rods vertically at corners, wrapped with No. 23 triangle wire mesh. The buttresses are reinforced with ¾-inch rods at corners parallel to slope of face and tied into column with ⅜-inch round rod stirrups.

INDEPENDENCE BOULEVARD BRIDGE, B. & O. C. T. R. R.

The roadway arches have a fillet of 2-foot radius at the columns and a rise of about 15 inches above the top of the fillet. The coping at top of arch projects 4 inches beyond face of same. At the crown the coping merges with a projecting medallion somewhat more elaborate than those on piers. The steel girders are wrapped with No. 23 gauge A. S. & W. Co. triangle mesh, to hold concrete, and prevent expansion and contraction cracks.

Sidewalk and Parkway Spans.—The sidewalk spans and the five parkway spans have a 2-foot radius fillet at junction with columns and a very small rise of about 3 inches above this. The coping for these arches is same as for large arches, but the top is carried across the bridge, level. The steel columns, encased in concrete, are 2 feet square and unornamented. Three-quarter inch round corrugated bars are placed at corners of columns and wire mesh wrapped around them. The fillets are also reinforced with bars placed at 45 degrees. (Corner and edges of all parts of structure have a bevel of ¾ inch).

Construction of Portals

Concrete.—The concrete used in the columns and arches was a mixture of one part Universal Portland cement and five parts of crushed limestone varying from ½ inch to dust, no sand being used. Special

care was exercised by the concrete foreman to see that all concrete mixed was of same proportions and consistency so as not to have varying colors in different parts of the work. No exact specifications as to mixture were issued, the matter of best mixture being left to the concrete foreman on the job.

Forms.—The forms used were of dressed lumber, but due to frequent use it was somewhat warped and not in the best of condition; but the results obtained in the finished structure are very good in spite of this. The forms for concrete covering of fascia girders were supported or hung from steel work of bridge and also by struts and braces to ground.

Placing Concrete.—The concrete for all columns was placed before any concreting was done on arches. The large columns were poured to the top in one operation, a ledge being left at junction with arch fillet. The smaller columns were poured to the bottom of fillets of fascia arches or girders. The roadway arches were poured separately as were the sidewalk spans and the parkway spans next to roadway. The intermediate section of three spans was poured at one time with an expansion joint at ends at the points where the expansion joints in steel work occur. Concrete was spouted directly into forms from a mixer mounted on a flat car.

No special facing was used in placing concrete, a good surface being obtained by thoroughly spading the concrete next to the forms. The small size of aggregate used was responsible for the fine surface obtained, very little difficulty being experienced with pockets or hollows in face.

Finishing Surface.—After the forms were removed and concrete had seasoned and dried out for a few days, the lips and ridges due to forms were chipped or filed off with chisel, coarse file or rasp. The surface was then wet and rubbed with a coarse carborundum brick until the surface was fairly smooth. After this a thin wash of cement and sand was applied and left to dry. The final rubbing was done with a fine carborundum brick until all of the cement wash had disappeared and the surface was as smooth as possible. All concrete was treated in this manner, including faces of abutments.

The advantage of this kind of finish is that the surface is a grayish white, is much lighter than can be obtained by any other method of treatment with the same kind of materials.

Comments

The only faults to be found in the structure which has just been completed are small cracks in concrete over the columns at joints between steel girders. These are due to the fact that concrete which is unreinforced save for wire mesh, is continuous over supports and the steel girders are not, and any deflection or movement in girders tends to crack the concrete. Otherwise the structure shows excellent workmanship and design, and stands out in happy contrast to the elevated railway structure over the boulevard a few blocks north with its attempted but poorly executed ornamentation.

The steel work was designed by the bridge department of the B. & O. Ry., W. S. Bouton, bridge engineer, F. L. Stuart, chief engineer, and fabricated by the Jones & Laughlin Steel Co.

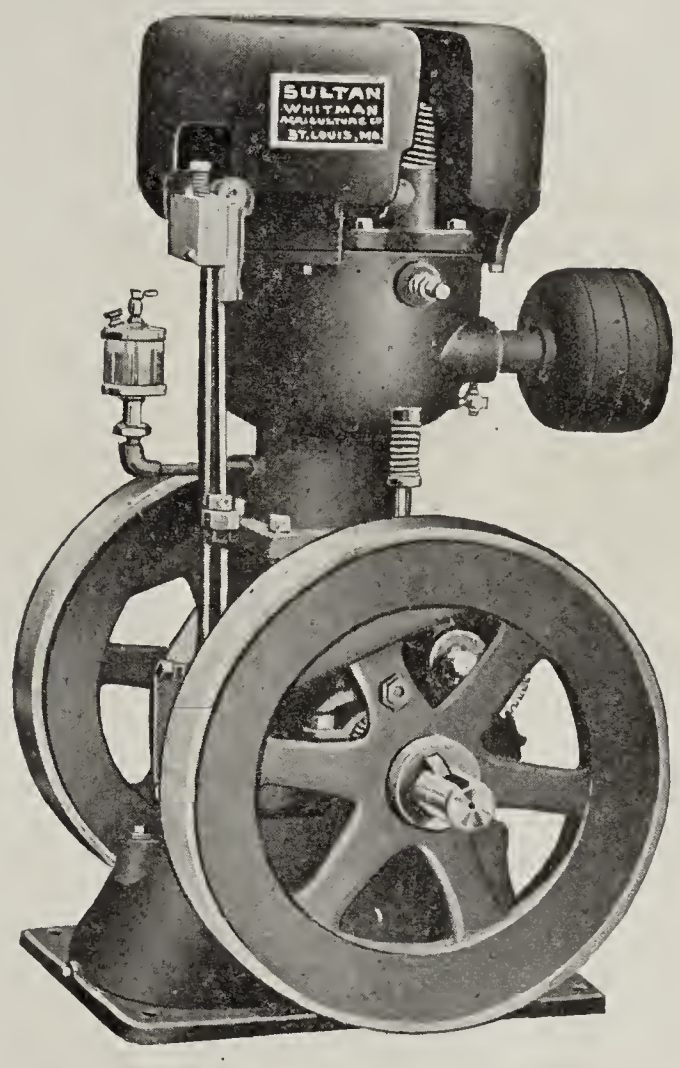
The general design of portals and ornamentation was executed by Mr. F. E. Lockwood, architect, Chicago, Ill., for the B. & O. R. R. The details of concrete portals were completed by the company under the direction of L. G. Curtis, district engineer, Chicago. The concrete work was carried out by company forces under the direction of Peter Olson, concrete foreman.

(Reprint from Railway Engineering & Maintenance of Way.)

A NEW KIND OF ENGINE FOR CONCRETE MIXERS

The Sultan Gaso-Kero Engine

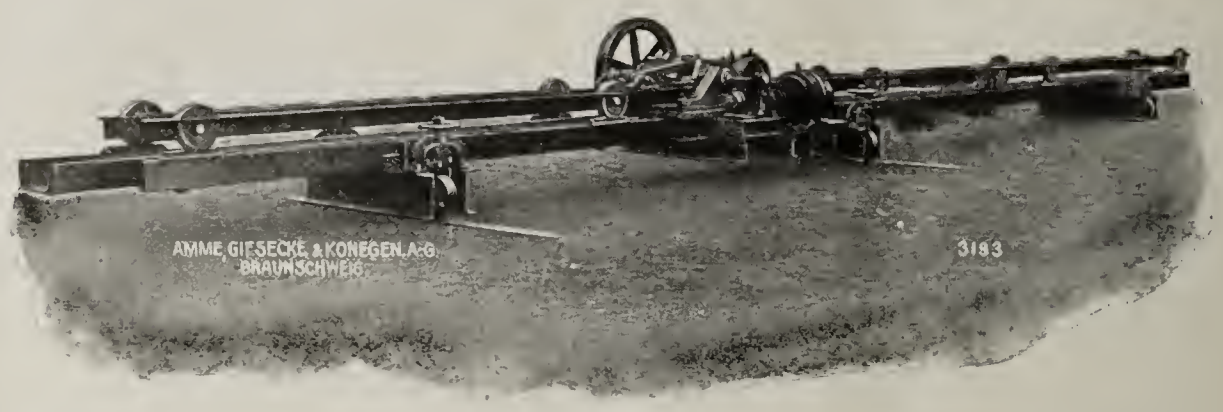
Whitman Agricultural Co., 6924 So. Broadway, St. Louis, has recently placed on the market the Sultan Gasoline Engine, which is particularly adapted to use with concrete mixers and for other purposes in which contractors are directly interested. Most contractors have some idea of the peculiar and unusual strains and stresses that hay press operation would throw on an internal combustion motor or, in fact, on any prime mover. The story of the Sultan is that the Whitman concern could find no gas engine which would satisfactorily drive their hay press under working conditions, and were forced to develop a motor which could do the work. Farmers these days demand that hay



SULTAN GAS ENGINE

presses be motor-driven—and the Sultan line is the result. A gas engine that will satisfactorily drive a hay press under field conditions, will stand up to a contractor's requirements at all times and intending purchasers of gasoline engines will do well to look into the Sultan before closing any deal. Remember there are only 54 parts to the Sultan. Less parts—less trouble. All these parts are of the finest material money can buy; finished to an absolute accuracy. No chance of burning out connecting rods as die cast bearings are used which can be replaced in a few minutes time by any novice. The valve in the head gives the engine the extreme power and can be removed in a minute's time. Write for Free Engine Catalog. Whitman Agricultural Company, 6924 South Broadway, St. Louis, Missouri, U. S. A

THE TORPEDO CONVEYOR



Patented

Cuts

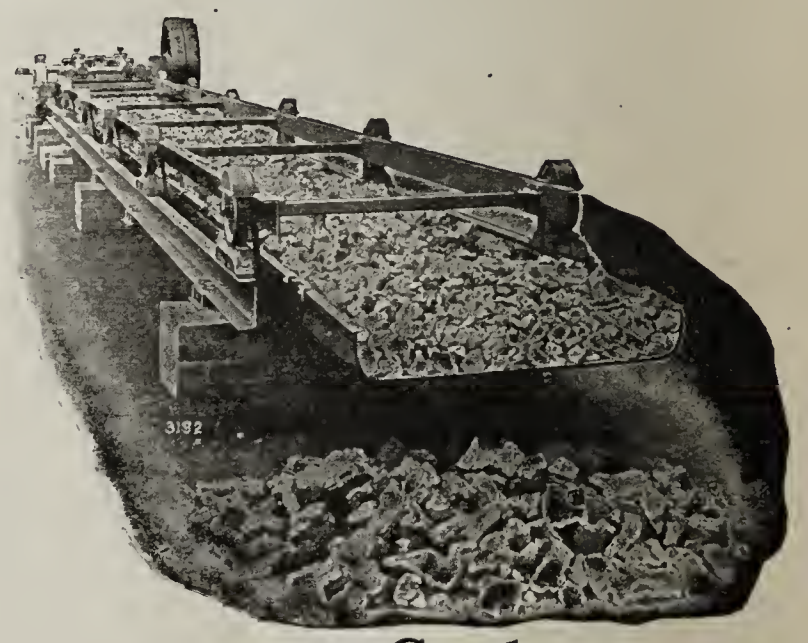
THE Torpedo Conveyor consists of a trough which is suspended from a carriage. This carriage rests upon wheels supported on short pieces of track resting on cast iron supporting brackets. A motion forward and back, is given to this carriage by means of a crank. Underneath the trough, or conveyor, there is a pneumatic cylinder, the piston rod of which is attached to the bottom of the trough and given a reciprocating motion by the conveyor trough. The forward motion of the conveyor compresses the air in this cylinder. At the end of the stroke this compressed air gives to the conveyor trough a quick reverse motion.

The pendulum arms by which the trough is supended from the carriage are in a vertical position at the extreme backward point of the throw of the crank, so that the motion of the trough on the forward stroke of the crank is forward and upward and on the return stroke is downward and backwards. This peculiar motion causes the conveyor trough, upon the return stroke, to drop away from the material which it contains and thus prevents friction or wear on bottom of trough.

CONVEYOR

It will therefore be seen that the movement of the conveyor trough is quite different from that of any shaking launder, or shaking screen and that the motions by which the material is carried forward and the trough itself returns are peculiar to this conveyor.

Simplicity in construction is one of the special advantages of this Conveyor, and fewer repair parts are required to keep it in constant operation. It is especially to be noted that the Conveyor may at any time be extended in either direction without change in drive.



Costs

The driving apparatus may be placed at any convenient point in the Conveyor or at either end. Material may also be fed or discharged to it at any point throughout its length.

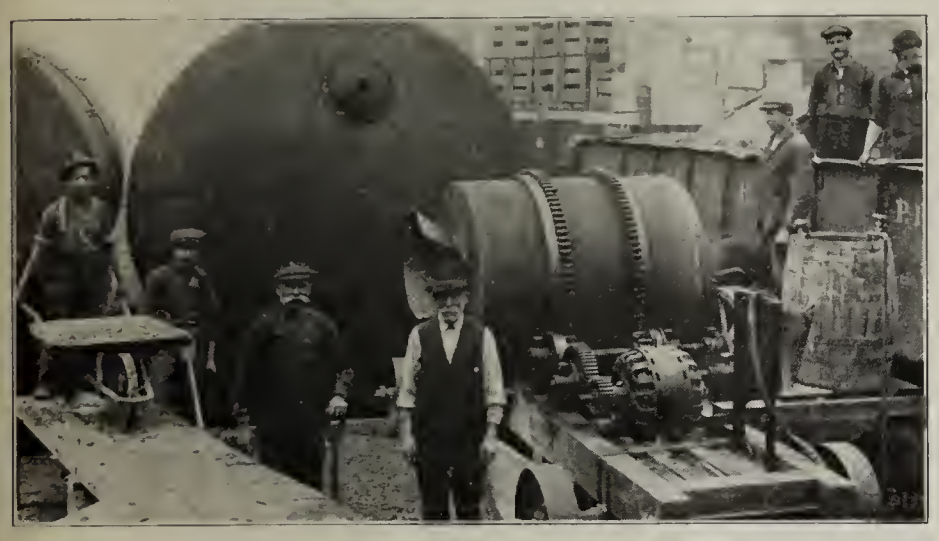
Chalmers & Williams CHICAGO HEIGHTS, ILLINOIS

MOTOR-DRIVEN CONCRETE MIXER.

Motor-driven concrete mixers are being used more and more extensively wherever electric current is available. The main reason for this growing popularity is that they are much more convenient to handle and are in general more economical than steam driven mixers.

The illustration shows how small the motor is in comparison with a corresponding engine and boiler. The weight is evidently greatly reduced, so that the outfit is more easily carried about and located where needed.

The elimination of the boiler also does away with



MOTOR DRIVEN CONCRETE MIXER

fuel, water, ashes, smoke, sparks, and noisy exhaust. A licensed engineer is not required, and any intelligent workman can operate the motor and give it all the care it needs in ordinary service.

The motor is controlled by means of a knife switch. When at rest, it involves no expense, as it is always ready to start without waiting for steam. As a result, annoying delays are often avoided.

The mixer in the illustration is driven by a Westinghouse induction motor.

NEW SOO RAILWAY TERMINAL

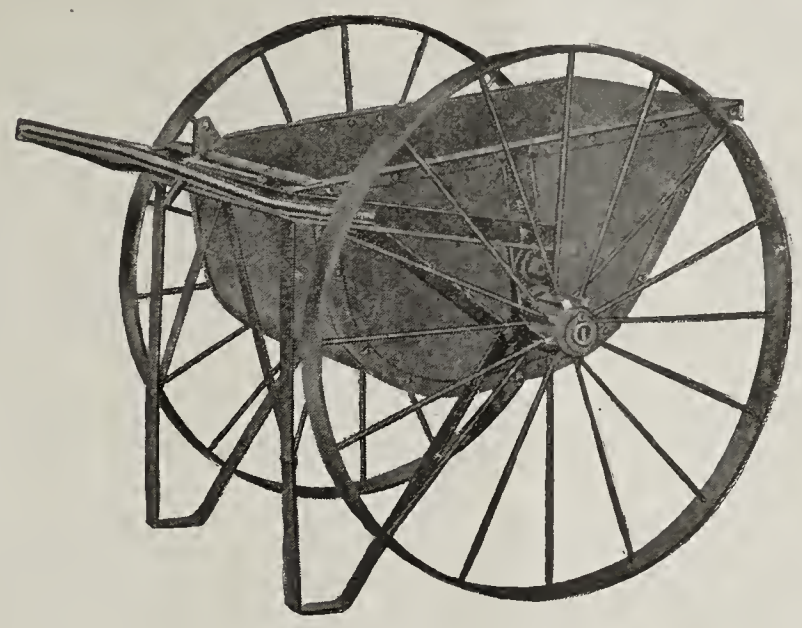
Every day there are being shipped to the Leonard Construction Co., at least seven cars of Universal Portland cement for use on the new Soo Terminal at Chicago. They have a storage capacity of 3,000 barrels but this is sufficient for only two days concreting. The quantities of cement are enormous. The entire work will require approximately 100,000 barrels of Universal which is used partly for footings and the floor of the first story, but largely for the heavy slab construction of the second floor which forms the floor of the train shed. The terminal covers a very large. area extending from Twelfth to Sixteenth Streets and is several blocks in width. The concrete is mixed at three points and distributed from high towers, but the distances are too great for chuting direct into the forms. The chutes, therefore, deposit the concrete in distributing hoppers which in turn fill two wheeled concrete cars with which the entire area of the work is covered. Shipments were commenced on January 7th.

CONCRETE SILOS

J. G. Berger, of Fort Branch, Ind., has been awarded the contract for building a concrete silo for J. R. Barrett, R. F. D. 2, Henderson, Ky. Also, one each for Harbert L. King and U. G. Connelly, of Corydon, Ky.

CONCRETE CARTS AND WHEELBARROWS

The Toledo Wheelbarrow Company, Toledo, Ohio, has just issued an attractive and valuable illustrated catalogue containing detailed information about their wheelbarrows and concrete carts. Their No. 3 Concrete Cart shown herewith is described as the strongest concrete cart on the market. It is constructed so that by releasing a strong spring clip the tray dumps, the handles and legs remaining stationary, preventing the cart from running back on the man handling the cart. It has a capacity of 5 cubic feet wet concrete, or 6 cubic feet of dry material. Length over all



NO. 3 CONCRETE CART

51 inches, width 36 inches. Tray is 14 gauge, reinforced with angle iron entirely around the bottom and top edge. Width 21 inches, length 36 inches, depth 16 inches. Wheels 36 inches diameter.

Their No. 42 "Bull Frog" Concrete Barrow illustrated on this page is equipped with "angle iron" wheel guard loop, which strengthens the frame and permits of forward dumping. Note the angle iron risers underneath the tray, which elevates the front end of tray so that in wheeling, the tray stands level, preventing the load from slushing over in the front.

NO. 42 BULL FROG CONCRETE BARROW

It is equipped with angle iron cross pieces which are bolted to the inside of the handles, and fitted on top of handles and under bottom of tray, making it impossible for the bottom of tray to bulge out of shape, which makes a very rigid frame and is a wonderful improvement over the common wooden cross pieces used by other makers. Write the Toledo Wheelbarrow Company for prices and catalog.

ALPHA CEMENT PLANT

Flying fragments of a flywheel which burst in the engine room of the Alpha Portland Plant at Alpha, N. J., severed the main steam pipe at the plant and killed two men.

CONCRETE SILO BLOCKS

A machine for the manufacture of concrete silo blocks of unusual and interesting design has been put on the market by the L. T. Kenny & Son Company, Hawarden, Iowa. This company for years has been manufacturing a patented and very successful machine for making well curbing. The machine makes two blocks at once. They received so many inquiries from their satisfied customers asking if they could make a silo block on the machine and as this could not be done they went to work on a machine which they have perfected for making a solid block

THE KENNY CONCRETE WELL CURB MACHINE
The Machine Makes Two Perfect Curb At a Time. It Is Made of Best Gray Cast Iron and Weighs Over 100 Pounds

4 inches thick, 8 inches high and 24 inches long with a deep crease cut in the top of each block to receive the reinforcing steel rod; the ends of the block are cored out so that when they come together they leave an opening 2¼ inches which is filled with liquid concrete thus making the block stronger at the joint than at any other place. The machine is so arranged that two of the blocks are moulded at once and in that way a cement silo can be built as cheaply as one of wood. Write them for prices and catalogues.

BARCO BRASS AND JOINT COMPANY.

Barco flexible joints are used in almost every industry where a flexible connection is needed to convey steam, air or liquids. They are also supplanting rubber hose everywhere. The increasing pressures and hard service, as well as the high price and low quality of rubber hose, make it expensive and undesirable.

Especial interest is being shown in the use of Barco flexible joints in connection with rock drills. The illustration shown herewith gives an idea of this ingenious and useful connection. The joints not only stand the hardest usage, but are treated so as to be rust proof. They may be swung out of the way during blasting and swung back ready for use in a moment. It is interesting to note that the railroad companies are rapidly doing away with rubber hose connections between engine and tender, between cars and in their round houses, because of the higher steam pressures necessitated by longer trains and by the electric lighting systems in vogue. Barco flexible joints are found on all the leading railroads. Write the Barco Brass & Joint Co., 230 No. Jefferson St., Chicago.

All steam shovels manufactured today are equipped with Barco flexible joints and the non-metallic gaskets which surround the balls in these joints have proved exceptionally durable and tight. One steam shovel inspector reported to us that he had taken one of our joints apart after 18 months of service and found very little wear. He thought they should be good for another 18 months of service without being repaired.

They have also been applied to the suction line of drag-line excavators, where they have been particularly successful, because they are not only a swivel joint in action, as well as a ball joint, but are absolutely tight under suction as well as pressure.

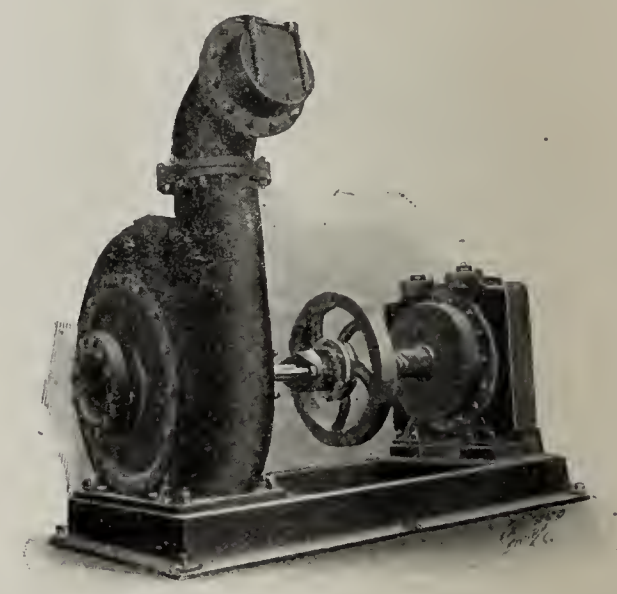
Barco flexible joints are also made in sizes from

BARCO FLEXIBLE JOINT

6 to 48 inch pipe, and the use to which these may be put is obvious to practical men. They are particularly tight under suction and can be used successfully in suction dredges, water works intake pipe, hydraulic power plants, for pipe lines over rough country, etc. The Barco Company will be glad to send, free of cost, to any of the readers of our paper their latest catalog and prices by mentioning Cement & Engineering News.

DAKE ENGINES AND CENTRIFUGAL PUMPS

A complete and practical catalogue containing detailed information on Dake engines direct-connected to centrifugal pumps for sand dredging has been received by the manufacturers, The Dake Engine Company. The various types and sizes of Dake engines and the working parts are excellently shown in high grade illustrations. The "Dake" engine is described as being distinctly different from any other machine



on the market and is the most simple and compact direct-connected set manufactured. The steam consumption of the Dake engine is about the same as that of the ordinary slide-valve engine and the "Dake" is especially adapted for direct connection to centrifugal pumps. Write for prices and full particulars of these sets, The Dake Engine Co., c|o Cement & Engineering News, 1117 Schiller Bldg., Chicago.

A GRAVEL-HANDLING PLANT.

A plant for unloading gravel from barges to elevated storage bunkers from which wagons are loaded by gravity, or to railroad cars for transportation to other points, is operated on the water front of Seattle by the Richmond Beach Sand and Gravel Company of that city. The elevated bunkers stand on pile footings at the head of a narrow slip. Along both sides of the latter are large warehouses on wharves extending out to the harbor line. Between each wharf and the slip is a pile trestle carrying a railroad track, and these two tracks connect at the shore end of the slip with the main line of the Great Northern and Northern Pacific Railroads.

Gravel is obtained from a pit on the shore of Puget Sound, about 30 miles by water from the bunkers, and the barges in which it is delivered are towed by tugs. A 1-yard Hayward clam-shell bucket, swung from a stiff-leg derrick mounted on a trestle over one of the railroad tracks and the adjacent warehouse, handles the gravel from the barges to an elevated hopper at the end of the bunkers, or to cars on either track. Practically all shipments are, however, for local distribution in wagons. The derrick is operated by a double-drum Lidgerwood hoist geared to a single-phase alternating-current variable-speed 60-hp. motor.

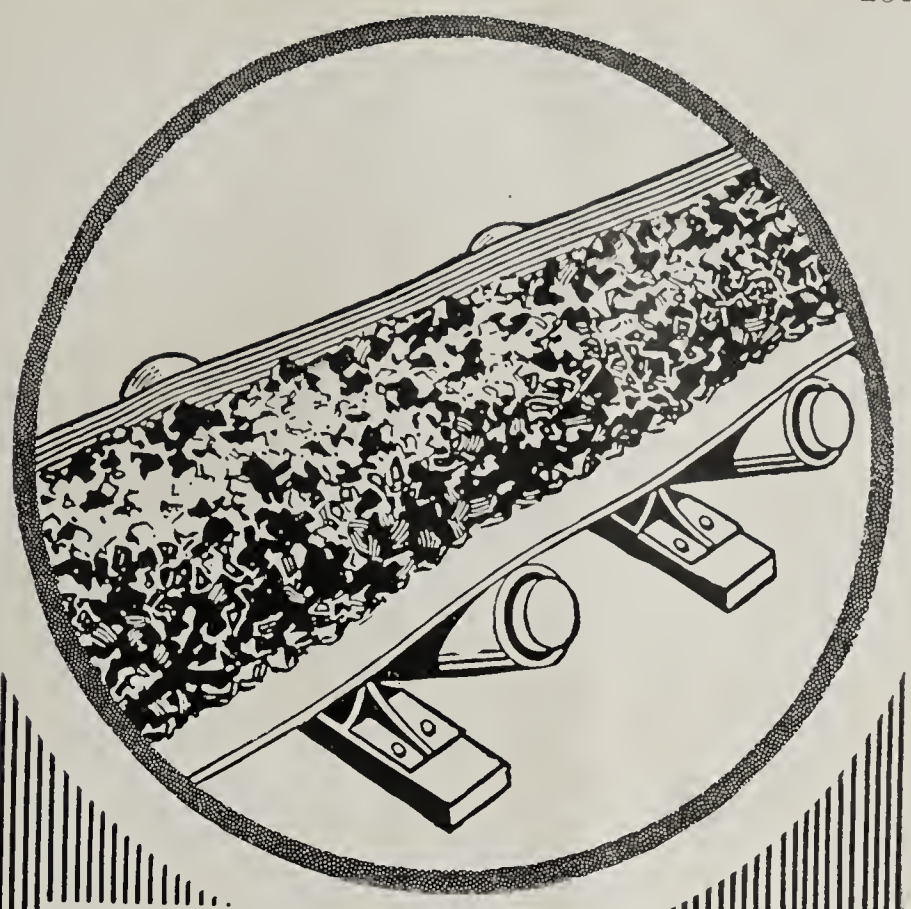
The bunkers are 20x120 feet in plan and provide a storage capacity of 1,000 cubic yards. They are divided into 24 separate bins so various sizes of material can be handled through them independently. The gravel passes from the elevated hopper at the end of the bunkers to a Jeffery drop pan conveyor which extends over the bin on the longitudinal center line of the latter. A roof is provided which covers the bins and conveyor.

The conveyor is geared to a single-phase alternating-current continuous-speed motor and travels at 70 feet per minute. Each pan section of the conveyor is carried by two pairs of flanged wheels which travel on a pair of rails on a frame spanning the bins. The rails are in sections over each bin so any one section may be removed. The conveyor is so designed that when each pan reaches the point where a section is out the rear end of the pan automatically drops down and the load is discharged into the bin below. As the conveyor proceeds the pan is then brought back into position without in any way interfering with the movement of the conveyor.

The bottoms of the bins are sloped to a row of outlet chutes along both sides. A roadway is built around the bunkers at the level of the street in front of the slip, so wagons approaching and leaving do not interfere. The chutes are set to deliver into the wagons and are each controlled by a gate operated from the latter.

Barge loads of gravel are delivered to the plant at intervals, according to the demands of the market. The gravel is unloaded from them at the rate of 100 tons per hour and a supply drawn from the bunkers as may be required. Under normal conditions the derrick will deliver from a barge to the elevated hopper at a rate of 60 cubic yards per hour. The conveyor will handle the gravel as rapidly as it flows from the hopper, its rated capacity being 80 cubic yards per hour.

The plant was designed and built by the Pacific Engineering Company of Seattle.



Avoid shut downs

Conveyor Belts that necessitate frequent shutdowns for repairs or replacements burn up money. Here is a belt that runs continuously all through its long service—always of unvarying quality and reliability throughout.

LONGLIFE CONVEYOR BELT

undergoes more hard service and handles more tons per dollar cost, than any other belt made

This is not a claim, but a statement of fact which we hope you'll ask us to prove.

Longlife Conveyor Belts are always flexible. They run straight, never run off the idlers or spill. Do their work day in and day out without attention or trouble of any kind.

Let us tell you the kind of service that Longlife Belts are giving to others whose conveying problems are similar to yours.

The B. F. Goodrich Company

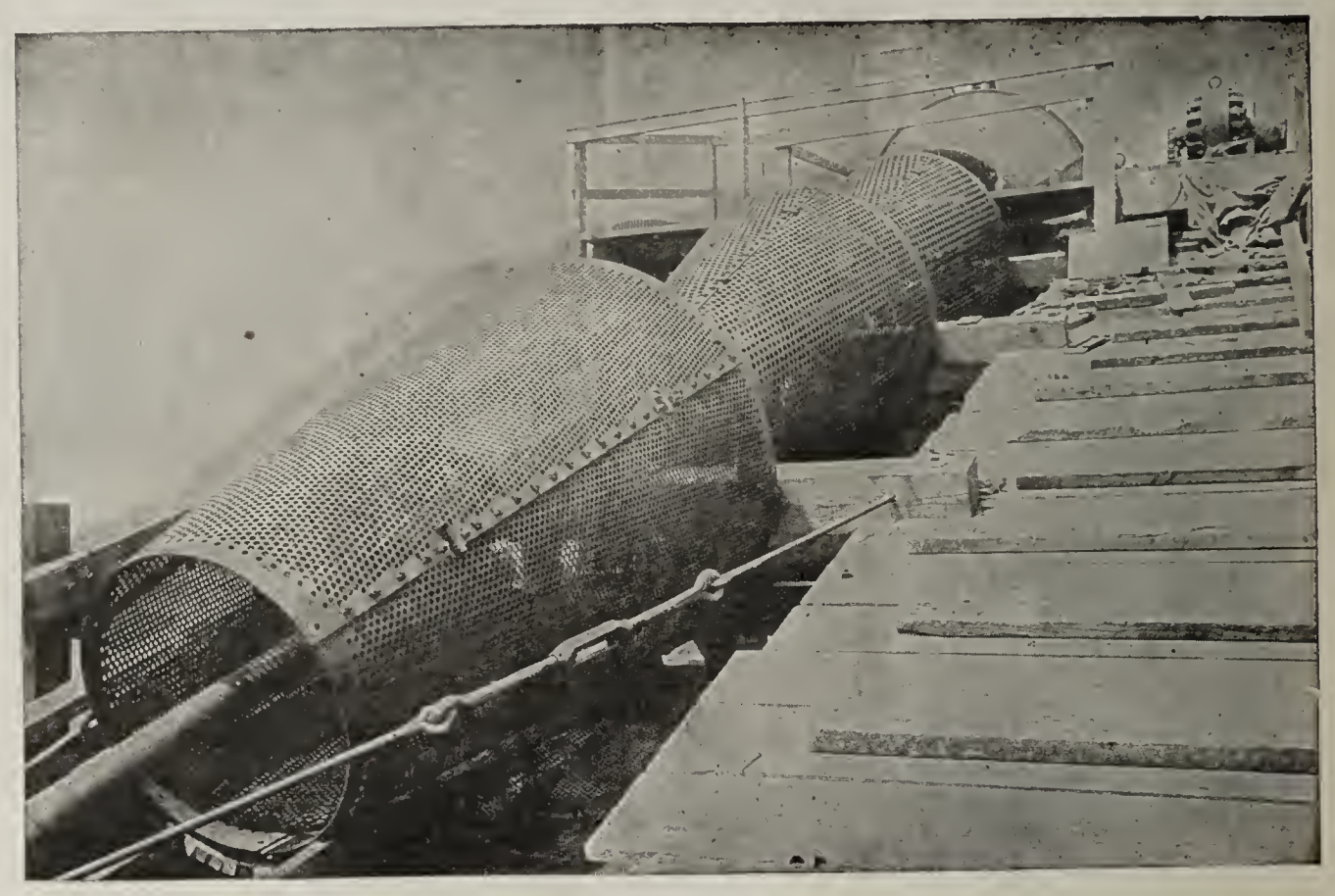
Makers of Goodrich Tires and Everything That's Best in Rubber

Factories: Akron, Ohio
Branches in all principal cities

There is nothing in Goodrich Advertising that isn't in Goodrich Goods

PRELIMINARY SCRUBBERS FOR WASHING SAND AND GRAVEL

In quite a number of pits and gravel deposits a considerable amount of clay and other impurities is found, and the screens will not prepare the material satisfactorily without some preliminary washing, before introducing it into the screens.



A SET OF DULL'S INCLINED CONICAL SCREENS, FED FROM PRELIMINARY SCRUBBER

We have placed on the market a preliminary scrubber for this purpose. It is a solid cylindrical shell, so formed as to retain continually a considerable amount of water and material. The rotation of this cylinder causes the material to tumble over and over in the water, to break up the impurities by a grinding action between the pebbles, writes the Raymond W. Dull Company.

The water flows in the opposite direction from the material, and a great percentage of the impurities is carried away by the water. Removal from the cylinder is effected by means of lifting blades, similar to those used in concrete mixers. Fresh water is introduced as the material goes thence to the screens, and after agitation in the screens the materials are thoroughly cleaned.

One of these preliminary scrubbers is shown herewith, at the head of a set of our Inclined Conical Screens.

This device may also be used as a mechanical sand separator, giving additional sand bin capacity.

Sand Separators

The Sand Separator is one of the most important parts of a washing plant. A poor one will spoil material in the bins about as fast as it is prepared. We were the first to design a steel mechanical appliance for the purpose of separating the soil water from the sand and have perfected a separator which now is quite extensively used in plants throughout the country.

The tank rocks on two brackets, one on either side. Valve openings on the front at the bottom are held against rubber-faced stops on the timber, by a lever with a counter-weight. The tank fills full of soil water, which runs off at the spillway at the top of the front. The sand quickly settles to the bottom of the tank and when it accumulates enough weight it causes the tank to tip forward, raising the counter-weight.

The tipping of the tank draws the openings in the front of the tank away from the rubber-faced stops, and the sand runs through the openings. When a sufficient amount of sand has escaped, the reduction of weight of sand in the tank allows the counter-weight to draw the tank back against the valve stops, closing the openings and stopping the flow. If the material comes into the tank uniformly, the tank will remain in such a position that the out-flow will be the same as the in-flow. Thus the tank action is automatic and continuous. This tank is made in three sizes, according to the capacity required and the nature of the material.

DULL'S SAND SEPARATOR IN PLACE

The very fine, undesirable sand is carried away with the waste water.

Fig. 2 shows the placing of the separator, to receive the sand and water direct from the screens. Below the spillway in front is seen the upper end of the launder by which the soil water is carried away.

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CONCRETE BRIDGES.

Daniel B. Luten, designing and consulting engineer of Indianapolis, Ind., owner of the Luten patents in concrete bridge construction, has compiled a booklet entitled "Reinforced Concrete Bridges in the Eastern Flood." As indicated by the title, the text of the booklet is given over to a description of the recent disastrous floods in Ohio, Indiana and Kentucky, and its effect on the bridges in those sections. A statement regarding the concrete bridges of Luten design, 2,200 in number, which were subjected to the flood with a failure of but two, is one of the features of the booklet. The booklet measures 9 by 6 inches and contains 24 pages. It is elaborately illustrated with photographic reproductions of Luten bridges which span streams in the flood district, and bridges of other construction which failed during the flood.

CITY GRAVEL PITS LEASED.

Leases covering the city's principal gravel pits were given to P. J. Moran by the city commission of Salt Lake City, Utah last night. Under one lease Moran obtains possession of the largest gravel pit on the north bench until May 1, 1919, and under the other he is given the Warm Springs pit until December 31, 1916.

Specific provisions by which the rights of the city and of all independent haulers are well protected are contained in each lease. Gravel and building material must be sold without discrimination and at rates named in the lease. For the larger gravel pit Moran is to pay the city $3,600 in annual installments of $600, and for the Warm Springs pit $2,550 is to be paid in annual installments. A ten-thousand-dollar bond is required for the larger and $2,500 for the smaller.

Marion steam shovel digging crushed stone in the quarry of the Lehigh Portland Cement Company at Fogelsville, Pa. This shovel was made in Marion, Ohio, by the Marion Steam Shovel Co. A number of churn drills are seen in the background. This type of drill is the safest and most economical for drilling blast holes.

SHOOTING BIG ROCKS AT PEMBERTON QUARRY

The American Lime & Stone Company, at their quarries at Pemberton, Pa., near Union Furnace, have a well drill, with which they drilled seven holes, each five and five-eighths inches in diameter and 163 feet deep, extending along the face of the quarry for 102 feet, and having a perpendicular drill face of 163 feet.

Eight thousand five hundred and fifty pounds of dynamite, running from 40 to 60 per cent in strength, was used. The amount of stone thrown out was approximately 32,477 tons, equivalent to 650 carloads.

Nothing was broken or injured in the explosion, excepting a small amount of track. The face of the quarry is about 300 feet from the railroad track.

E. H. Shainline, of Norristown, had charge of the blasting. It was probably the most successful deep hole drilling and shooting that has been done in the limestone quarries of Pennsylvania.

Several weeks ago the city attempted to lease the same pits to Moran, but a storm of protest from the small gravel haulers resulted in the defeat of the leasing resolution. The leases given last night assure ample protection to the small haulers and no protest is expected.

LIMESTONE PLANT

The West Virginia Limestone Co., Wheeling, W. Va., has awarded the last of their contracts for the installation of their limestone plant at their quarries, to the firm of Waweatt & Wiley, contractors of St. Clairsville, O., for the erection of the receiving and discharge stations and for four towers 40 feet high for carrying their aerial tramway. The lumber contract has been assigned to the Cecil Lumber Co., of Elm Grove, W. Va. The Brodrick and Bascom Rope Co. has constructed the machinery and are supplying the cables for the aerial tramways. The crusher, pulverizer and accompanying equipments are products of the Wheeling Mold and Foundry Company.

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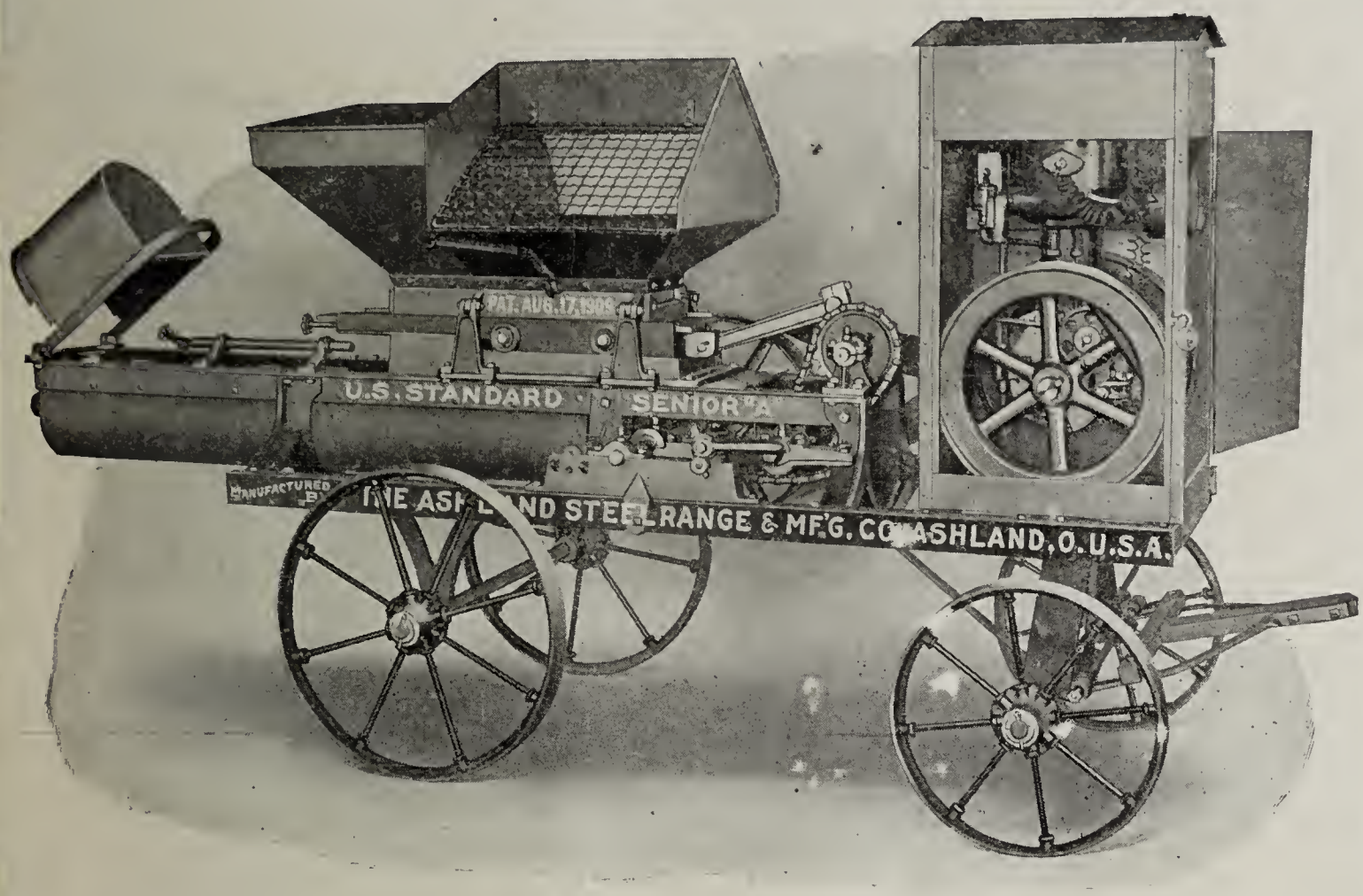

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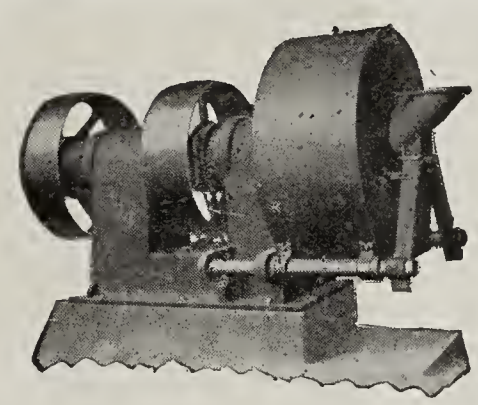

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VIEWS AT THE CHICAGO PORTLAND CEMENT PLANT, OGLESBY, ILL. AERIAL TRAMWAY, SPANNING VERMILLION RIVER, CAPACITY 2,000 TONS OF MATERIAL DAILY.

DUST COLLECTING DEVICE

Mr. W. A. Perry a cement-expert from the Tidewater Portland Cement Co., Union Bridge, Md., was in Birmingham, Alabama all of last week making a series of tests with the Douglas Dust Separator.

This improved Dust Collecting System was installed at the Southern Cement Co.'s plant at Birmingham about three years ago and has proved a complete success. It is the invention of Mr. John Douglas an expert cement engineer and patents are now pending in the United States and foreign countries.

Before leaving Birmingham Mr. Perry stated that he considered the Douglas Separator was the only machine on the market today that would successfully handle fine dust from Rotary Kilns, etc.

This machine is being built by the Scheafer Manf'g Co., North Birmingham, Alabama.

CHARGE RATE DISCRIMINATION

Complaint of the Kansas Portland Cement Co. against the M. K. & T. Ry. were heard by Special Examiner Gibson of the Interstate Commerce Commission recently in Chicago. The cement company asked reparation for alleged overcharges for carload shipments of cement from Gas, Kas. to Alhambra and Pasadena, Calif.

CEMENT PLANT NEAR PHOENIX PRODUCES 250 BARRELS DAILY

The new factory of the Arizona Portland Cement company, five miles east of Phoenix, Arizona, is now turning out 250 barrels of cement each day. Its capacity is 500 barrels, but only one furnace is running. Thirty men are employed and the force is to be increased to 50 says the Phoenix "Times."

This plant is the only cement mill in Arizona.

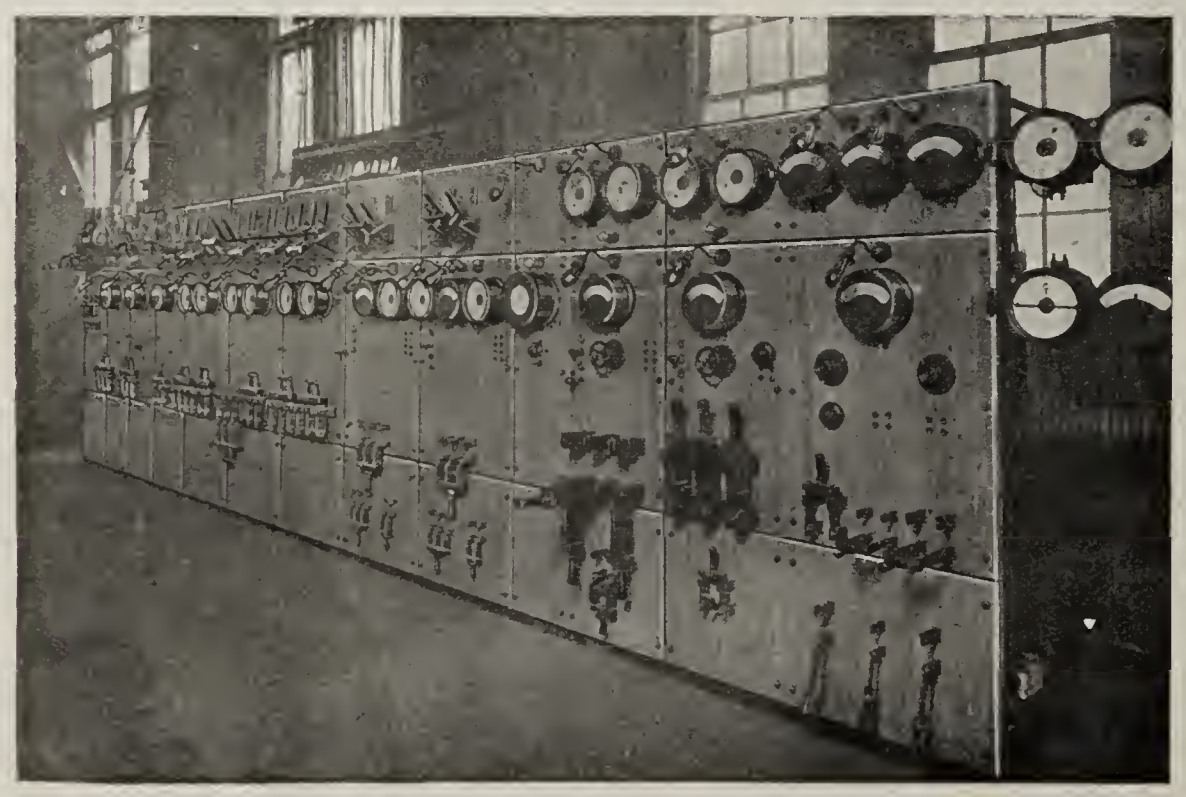
Lime for the cement is brought from Winkelman and the clay from some beds four miles west of Phoenix on the Buckeye railroad.

KANSAS CEMENT PLANTS

The cement companies of the Kansas gas belt are asking the utilities commission for a re-adjustment of the freight rates on their products. They allege the present tariffs discriminate against them in favor of the cement plants in the Kansas City district. A hearing will be held this week.

TEXAS CEMENT COMPANIES

The cases against the cement manufacturers of Texas, alleged to constitute a trust will come up this month. The assistant attorney general and a special master is now taking testimony.



VIEWS AT THE CHICAGO PORTLAND CEMENT PLANT, OGLESBY, ILL. SWITCHBOARD — CONTROLLING POWER GENERATED BY WESTINGHOUSE-PARSONS TURBINES.

CEMENT AND ENGINEERING NEWS

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

Advertising Rates Sent on Application

JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, SEPTEMBER, 1913

PUZZUOLANA-CEMENT MIXTURES

The opening of the Los Angeles aqueduct, in which a mixture of Portland cement and puzzuolana has been used successfully on an unprecedented scale, brings once more the advisability of puzzuolana admixtures to the front.

The prejudice that formerly existed against the use of puzzuolana admixtures has been definitely overcome. This is true to such an extent that, several years ago, the German Government declared cement containing admixtures of up to 30% of a natural or artificial puzzuolana to Portland cement to be fully equal to pure Portland cement, a decision which was the outcome of elaborate experiments carried on for a period of 30 years. The Los Angeles engineers, therefore, knew from the experience gained in Europe that the regrinding of Portland cement with a natural puzzuolana would assure them of results at least equal to those obtained with pure Portland cement and that it would, at the same time, considerably reduce the cost of the cement.

As, furthermore, the available literature proves that an admixture of puzzuolana to Portland cement increases the resistance of the cement to sea-water and to similar salt solutions, engineers and contractors are now fully aware of the advantages that accompany the application of Portland cement reground with puzzuolana and are prepared to make the widest use of it in the future.

The West will be an especially fruitful field for the manufacture of puzzuolana-Portland cement on account of the high price of cement. The cost of quarrying, crushing and marketing the puzzuolana amounts to very little, especially if the puzzuolana deposits are located near the water.

Moreover, the West, with its numerous extinct volcanoes, is fortunate enough to possess large deposits of puzzuolana material which, if used as an admixture to Portland cement, cheapens the cost of concrete work and at the same time increases the resistance of the cement to the mechanical and chemical influences of the water.

The object of an admixture of puzzuolana to Portland cement is to retard or prevent the disintegration of the latter. The chemical ingredients making up the calcined product which we call Portland cement are high-limed compounds of lime, or calcium oxide, with silica, alumina and iron oxide. Upon addition of water to the powdered Portland cement, the finest particles are decomposed at once into their constituents, calcium hydrate on the one hand and silica hydrate, alumina hydrate and iron hydrate on the other, which in time may chemically combine and form new hydrated salts, containing less lime than the original cement clinker, or may act one upon another merely in a mechanical way, namely, by precipitation on their surface of a certain amount of hydrated lime. Whatever the case may be, the advocates of both theories must admit that a large part of the lime contained in the calcined product, which is liberated under the action of the water, subsequently never enters into any combination. It forms hydrated lime, or calcium hydrate, a soluble substance, which is easily dissolved by the water and carried away, rendering the concrete porous, or which precipitates, in sea-water or refuse water of mines, both of which contain a high percentage of sulphates, calcium sulphate, a substance which causes great damage to the cement by crystallization as such or after previous combination with the alumina compounds of the cement.

The desired hydrates of silica, alumina and iron oxide are found in nature in the form of puzzuolanas, or tufas, volcanic products created by the action of water or steam upon basaltic or granitelike molten formations. They can be artificially obtained by running molten blast furnace slag into water. In both cases the original compounds of the basalt, granite or slag are completely decomposed into their constituents and, furthermore, transformed into comparatively loose material which can easily be crushed. The most valuable part of the various chemical ingredients to be found in a natural or artificial puzzuolana is the silica hydrate, so-called "soluble" silica which, in distinction from quartz silica, powdered quartz, is soluble in a 10 per cent solution of sodium carbonate. Such silica combines readily with calcium hydrate and forms an excellent hydraulic cement.

Natural puzzuolanas have mostly been found to be superior to artificial puzzuolanas, that is to say, granulated blast furnace slag. Most blast furnace slags are very unreliable because they frequently change in composition and because of their high contents of alumina. On the other hand, we can not too highly recommend the admixture of natural puzzuolanas, volcanic products which, upon careful testing, have proven to be uniform in composition and have given results not only "just as good," but far superior to pure Portland cement.

Seventh Chicago CEMENT SHOW, February 12-21st, 1914.

Tenth Annual Convention AMERICAN CONCRETE INSTITUTE, Chicago, February 16-20th, 1914.

NATIONAL CONFERENCE ON CONCRETE ROAD BUILDING, February 12-14th, 1914.

A Cost and Time Study of Big Blast Hole Drilling

By R. R. Sanderson

(Continued from page 246)

However, the above is a good illustration of adopting the spacing to meet existing conditions and by so doing reducing ultimate costs.

My next illustration is drawn from the experience of one of the country's largest crushed rock producers. Here the largest shovels and largest crushers are used.

As the company in question has been using big machines for over three years, it would seem that they would know the game so thoroughly that they would not be caught, all of which illustrates the point I want to make.

When they first installed the big drills they determined, after considerable experimenting, that a spacing of 17 feet back and 14 feet apart gave them best ultimate results.

A short time ago an economical idea came to one of the officers and in direct opposition to their powder man's advice, the holes were ordered spaced 22 feet back and 18 feet apart.

This new spacing was adopted and a 10-hole shot made.

Under their old system their shovels were each loading from 1,200 to 2,000 tons per day. Under the new spacing the rock came out in such condition that 400 tons per day per shovel was the best they could possibly do. Besides the low tonnage output, the bottom of the quarry was left in such shape that it had to be extensively block-holed to smooth it up.

The above results show such a glaring example of disastrous economy that they need no per-ton figuring to explain them.

In figuring the spacing of holes for a shovel operated plant, the two main factors to be considered are the size of breaker installed and the size of shovels used. Thus when shooting for a mammoth crusher or the largest size of breakers or rolls, it is possible to reduce the ultimate per ton drilling and blasting costs below what they would be with a smaller crusher supplied by shovel loading.

However, the above rule regarding per ton cost depending upon size of crusher, does not apply to hand loading plants, as in this kind of operation no large stones go to the crusher, and thus an extra large crusher is not an advantage. As a general rule in big-hole work I would say that the primary per ton drilling and explosive costs are less for hand loading than they are for shovel loading. I realize that this is not the generally accepted idea, but I have found it to be so in many plants. Furthermore, there are certain quarries possessing rock formations of such character that the total drilling and explosive costs for hand loading will be even lower than if the quarry were being shovel worked.

As explaining the reason for this would involve a considerable discussion, I will not go into the matter further and have only mentioned it on account of the fact that so many have the idea that a hand-loading plant is at a serious disadvantage with a shovel-loading plant on the drilling and blasting end.

In lime plants there is sometimes another item which enters into the calculation besides the three items overhead, drilling and blasting, this being the item, spalls.

In those plants where the avoidance of spalls is a serious proposition, this item must be taken into consideration and the spacing and explosive so proportioned as to give best results along this line. Obviously this is a proposition to be figured for each separate plant, as what might be excessive spalls at one plant would not be so considered at another.

As a general proposition, I would say that it is cheaper in primary drilling and explosive costs to do shooting without spalls, but that it is a little higher in secondary drilling and explosive, also higher in overhead.

While the manner of spacing of the holes has quite a bit to do with eliminating spalls, still the biggest part of it rests with your powder man, as it is largely a matter how the holes are loaded and the kind of explosive used.

My discussion up to this point has had to do with drilling costs in relation to quarry work as a whole. For the benefit of those members of the National Lime Manufacturers' Association who are operating big drills, also for the benefit of those of the members who are figuring on the proposition, I will give a short analysis of the machine used for producing the big holes and a few tests to apply to determine whether or not a big drill is being operated at highest efficiency.

As all of you are more or less acquainted with the general appearance and general construction of the well-driller type of blast hole machine, I will not enter into details concerning such features. I will, however, devote a little time to discussing the proper size of tool equipment, as this very directly influences the per-foot-of-hole costs.

In drilling with well driller tools probably 80 per cent of the hole made is due to the crushing effect of the heavy weight, while the other 20 per cent is due to the chipping action of the edge of the bit. Under such circumstances it is readily apparent that the best way to increase the amount of hole made is to increase the weight of the tools.

However, as the weight of the tools is made greater, it becomes necessary to increase the size and strength of the machine in order to handle them satisfactorily, and thus a point is finally reached where the extra weight and unwieldiness of the machine offsets any gain made by having heavier tools. The determination of this point is a problem which cannot be solved by fixed rules, it being necessary to move according to experience gained by trials and tests.

Experience up to the present time seems to settle upon a weight of tools of about 1,150 pounds for 5 to 5½-inch holes, and to get this weight a drilling stem 4 inches in diameter by 20 feet long is used.

After having settled upon the size of tools to be used, the elements, which is a big drill influence the number of feet made per unit of time, leaving out of consideration the hardness of rock and such exterior influences, are:

Number of strokes of drill per minute.

Number of feet drilled before bailing out.

Time required to pull the tools.

Time required to bail out.

Time required to let the tools back into the hole and start drilling.

The above are what we will term the primary elements, being so called on account of their importance.

We also have secondary elements, which are:

Time required to move machine from one hole to the next and start drilling.

Time required to change bits.
Time required to splice ropes.
Time required to change rope end for end.
Time required to put on new rope.
Lost time from other causes.

The secondary elements, considered separately, are not as important as the primary, due to the fact that they are less often repeated and thus a slight loss of time on any one of them does not have much effect on final results.

Before taking up a detailed discussion of the primary and secondary elements, and in order to make clear the point I want to bring out, I will state that a drilling machine, either tripod or well-drill has what we might term productive and non-productive periods. The productive period covers that time in which the drill is making hole—that is, striking on the rock, and the non-productive covers all other time. It is readily apparent that, other things being equal, the machine which is able to reduce its non-productive time to the minimum will drill the most hole.

Now let us first take up the number of strokes of drill per minute.

To illustrate the importance of maximum number of blows per minute, we will assume that in a day's drilling the productive period covers seven hours and that we are getting 55 strokes per minute during the seven hours. Assume further that in seven hours we drill 60 feet, then the total number of blows delivered in cutting the 60 feet is 240x55, or 23,100. Dividing 23,100 by 60, the number of feet drilled, gives us 385, the number of blows required to drill one foot.

Suppose now we are able to increase the number of blows to 59 per minute, which will give us a gain of 1,680 in the seven hours. Dividing this 1,680 by 385, the number of blows required to drill one foot, gives us 4.3, which shows that an increase of 4 blows per minute has added 4.3 feet to the day's work.

A properly constructed big drill will, on holes up to a depth of 35 to 40 feet, deliver 58 to 60 strokes per minute, and thus there is absolutely no excuse for a drill man allowing his tools to run along about 50 strokes per minute, like so many of them do.

Having brought the number of blows per unit of time up to the maximum, the next step is to try and increase the total number of blows per day by cutting down the non-productive time, thus throwing more time to producing time.

PLANT OF FRANCE BROS. CO., WATERVILLE, OHIO, EQUIPPED WITH NO. 7½ AUSTIN GYRATORY CRUSHER, ELEVATOR, SCREEN AND AUSTIN CARS.

Taking up the number of feet drilled before bailing out. Each time the hole is bailed, three operations are involved, namely, hoisting the tools, running the bailed and then lowering the tools back into the hole and again starting drilling operations.

Suppose, now, that the time involved in the bailing operation is divided as follows:

Hoisting the tools.....2 minutes
Running the bailer..... 4 minutes
Returning the tools to the hole... 2 minutes

Thus each time the hole is cleaned out we have taken eight minutes off of the production time.

Assuming as in the beginning, a daily footage of 60 feet and also assuming that on an average of 4 feet is drilled before bailing, then we have 15 bailing periods, or a total loss of 8x15, or 120 minutes.

Now, suppose that by careful attention to details we are able to reduce the bailing time by one-half. We will then be adding one hour to our production time, which will increase the amount of hole 9.45 feet per day.

There is another method of eliminating this lost bailing time, and that is by bailing less often. This must be handled carefully, however, as what you will gain in time you may lose in efficiency due to the tools not doing their best work in a hole full of thick sludge.

The methods of analysis given above as applied to the primary elements should also be applied to the secondary elements, and all leaks of time stopped.

As in big hole drilling, the periods of heavy labor do not come often, the drill man should, when these periods do come, be expected to move energetically and should exert himself to the utmost, and if you are unable to get such an action out of your man, it is best to get another man.

A good big-hole drill man cannot be developed from a dullard; to get the highest efficiency out of a big drill requires not only a close watch by the drill man to prevent time leaks, but also requires a nice judgment on the method of running the tools, the proper amount of rope to let off at a time, the proper tension to maintain in the rope, planning the work ahead to prevent delay, etc. Sometimes tripod drillers make good big-hole drillers, but as a rule it takes longer to break them in than it does to break in a green man.

There is no fixed rule you can apply by which you can pick out a good driller. Some of the very best big-hole drillers I have ever seen were foreigners, Italians, Germans, Swedes, Austrians and Hungarians, but whatever their nationality, they have invariably been men of quick perception and a good deal of nervous energy.

The costs involved in operating a machine are:

Drill man, helper, power, sharpening bits, repairs and renewals, interest and depreciation, oil, superintendence.

The wages of an average big-hole driller will range about the same as a tripod driller. On this point I would say, however, that an extra 50 cents a day for the proper kind of a man is money mighty well spent.

The helper's wages will be the same as ordinary labor, as all that is required of him is dumping the bailer, helping in moving up the machine and work of such nature. The one exception to what I have just said is when a steam machine is used, in which case the helper must, of course, look after the boiler.

The cost of power depends upon the kind used.

With gasoline power, the gasoline at 12 cents per gallon, the cost ranges from 72 to 96 cents per day.

With electric power at 2 cents per kilowatt, the cost ranges around $1.25 per day.

With steam power, the cost depends upon the cost of water and coal delivered at the machine. Ten to twelve barrels of water and 500 to 650 pounds of coal will be required per day.

With compressed air, the cost will be about the same as a 3¼-inch tripod.

The cost of sharpening bits will depend upon the hardness of the rock. On rock of medium hardness, one bit will last at least a full day, and will require three-quarters of an hour to an hour to dress.

Repairs and renewals will range from 65 to 75 cents per day. Fifty cents of this will be for drilling cable, which has to be replaced every 30 to 60 days.

Interest and depreciation: Figuring a total cost of $1,000 for the outfit, the interest will run 20 cents per day. The depreciation, assuming a life of 10 years, will be 33 1-3 cents per day. In respect to depreciation, however, the wearing out of a big drill is a good deal like the Dutchman's pocket knife, "sometimes the handle, sometimes the blade," and thus quite a bit of this is covered by the item repairs and renewals.

Oil cost is so low as to be almost negligible, but I have included it to cover all items. We will say oil costs 10 cents per day.

Superintendence cost on a big drill is much lower than on a tripod drill, for the reason that a large amount of work can be laid out and assigned to the drill man without further attention on the part of the superintendent.

Bearing in mind the plan which I have followed out in treating of big-hole drilling, not as a separate item which stands alone and has no influence on other quarry operations, but as a part of a complete cycle of operations, I do not believe that I can do better in the way of a summary than give some comparative data showing the difference between big-hole costs and small-hole costs.

In giving the cost data which follow, I do not give the names of the plants, as I feel that this would be a breach of confidence on my part. Also on some of the plants the data is incomplete, as the records of the plants were so kept that I could not arrive at the information needed.

First Plant:

Material gotten out for	Lime and crushed rock
Quarry breast	34 feet
Stratification	6 to 8 feet
Method of loading	Hand
Average size tripod holes	2⅛ inches
Size of well drill holes	5 inches
Spacing tripod holes	5½x5½ feet
Spacing well drill holes	14x11 feet
Cost drilling per ton, tripod	2.35 cts.
Cost drilling per ton, well drill	.87 cts.
Cost shooting per ton, tripod	3.15 cts.
Cost shooting per ton, well drill	2.21 cts.
Drilling per day, tripod	95 feet
Drilling per day, well drill	80 feet
Saving in drilling per ton	1.48 cts.
Saving in shooting per ton	.94 cts.
Saving in overhead per ton	1.82 cts.
Total saving per ton	4.24 cts.

Spalls were reduced 25 per cent, but as this plant uses the same rock for crushing and burning, this item was of no value to them.

The high overhead saving in this case was due not only to better output, but also to the fact that the ledge contained three or four different kinds of stone which by previous methods of bench shooting had to be mixed by hand. By shooting everything down together, the stone was mixed in the shooting.

Second Plant:

Material gotten out for	Crushed rock
Quarry breast	50 feet
Stratification	2 to 10 feet
Method of loading	Hand
Average size tripod holes	2⅛ inches
Size of well drill holes	5½ inches
Spacing tripod holes	5x5 feet
Spacing well drill holes	13x13 feet
Cost drilling per ton, tripod	4.3 cts.
Cost drilling per ton, well drill	.88 cts.
Cost shooting per ton, tripod	3.2 cts.
Cost shooting per ton, well drill	2.8 cts.
Drilling per day, tripod	50 feet
Drilling per day, well drill	50 feet
Saving on drilling per ton	3.42 cts.
Saving on shooting per ton	0.4 cts.
Saving on overhead per ton	1.7 cts.
Total saving per ton	5.52 cts.

The item overhead was derived from an increase of 75 tons per day due to better loading conditions.

You will note that I have made no allowance for the increased profits due to the additional 75 tons, but have figured only the actual saving. If it is true, as I am being sometimes told by stone producers, that they are losing money on every ton of stone produced, it would probably be better for me not to mention this extra 75 tons, as figuring on their basis, the greater the output the greater their loss.

The records which I next give cover a rather peculiar limestone formation. The strata are not only very thin, averaging 2 to 4 inches, but they appear to be without continuity, being more in the form of thin kidneys loosely laid up. When drilling this formation with tripod drills, a great amount of caving trouble was experienced. Some days this was so bad that a tripod drill would not complete a single hole. I make this explanation to account for the high tripod drilling costs.

Third Plant:

Material gotten out for	Cement
Quarry breast	30 feet
Stratification	thin, shelly
Method of loading	Shovel
Average size of tripod holes	2½ inches
Size of well drill holes	5½ inches
Spacing tripod holes	6x6 feet
Spacing well drill holes	14x14 feet
Cost drilling per ton, tripod	7.0 cts.
Cost drilling per ton, well drill	0.6 cts.
Cost shooting per ton, tripod	3.5 cts.
Cost shooting per ton, well drill	2.8 cts.
Drilling per day, tripod	35 feet
Drilling per day, well drill	90 feet
Saving on drilling per ton	6.4 cts.
Saving on shooting per ton	0.4 cts.
Saving on overhead per ton	(no data)
Total saving per ton	6.8 cts.

The fourth and last comparative record is taken from a large-capacity crushed rock plant. Previous to installing well drills they were drilling a 40-foot ledge with large air drills. Although the operation of the drills was not very satisfactory on the deep holes, thus bringing up the drilling cost to a high figure, still the ultimate costs derived from working the high breast justified the high per-ton drilling cost.

Fourth Plant:

Material gotten out for	Crushed rock
Quarry breast	40 feet
Stratification	2 to 8 feet
Method of loading	Biggest size shovels
Average size tripod holes	5-inch top, 3¼-inch bottom
Size of well drill holes	5½ inches
Spacing tripod holes	8x8 feet
Spacing well drill holes	18x12 feet
Cost drilling per ton, tripod	5.76 cts.
Cost drilling per ton, well drill	.82 cts.
Cost shooting per ton, tripod	3.98 cts.
Cost shooting per ton, well drill	2.94 cts.
Drilling per day, tripod	34.6 feet.
Drilling per day, well drill	64.2 feet
Saving in drilling per ton	4.94 cts.
Saving in shooting per ton	1.04 cts.
Saving in overhead per ton	(Unable to figure)
Total saving per ton	5.98 cts.

The four comparisons made will give you a good general idea of how the amount of saving runs. I know of some plants that are doing even better than the figures which I have given, while there are, of course, others which do not show up so well. One thing which has handicapped me a good deal in working out comparative costs is the lack of attention paid to cost records by the quarrymen, most of whom seem to carry such things in their heads.

To those who desire it, I will be glad to furnish further data covering different kinds of plants and quarry formations. Your honorable president, Mr. Carson, has had one of the big machines installed for some time, and is, I believe, in a position to give an authoritative opinion.

WELDING A GYRATORY CRUSHER SPINDLE

An interesting application of the thermit welding process has recently been made by the San Francisco office of the Goldschmidt Thermit Company. The Healy-Tibbitts Construction Company of San Francisco was operating a No. 3 McCully gyratory crusher at its rock-crushing plant and was at work making a large quantity of crushed rock for one of its contracts which necessitated steady deliveries in order to keep up with the field force engaged on the work. The centre spindle of the No. 3 crusher broke, thus temporarily putting the entire plant out of commission and stopping deliveries of crushed rock until repairs could be made. As a spare spindle could not be obtained in San Francisco, the delay incident to sending East for the part was a serious matter to the contractor. After giving careful consideration to the situation, L. S. Rosener, consulting engineer for the contractors, referred the matter to the San Francisco office of the Goldschmidt Thermit Co., which agreed to undertake the work of making the repair.

The spindle was shipped to San Francisco from the rock quarry at Point Richmond, Calif. When the broken spindle was received. It was in two pieces and fractured on the line indicated at the end of the V thread. The shaft was first put in the lathe to be tested for alignment, and it was found to be one-eighth out of true; 1⅛ inch of stock was then turned off to provide space for the thermit, and a 2-inch pin was fitted into the larger end of the shaft and a hole was bored 4½ inches deep in the smaller piece of shaft, into which the pin was fitted, thus insuring perfect alignment after welding. This being done, the shaft was placed on V-blocks at each end, and blocks also supported the pin near the middle, and one piece of shaft was strapped down to the blocks. A mold box was made with wooden sides which were made to taper so that the gate would have sufficient incline from the vertical. The end containing the torch holes was of No. 10 steel. One No. 8 crucible was used, and the mix consisted of 150 pounds of thermit, 2½ pounds of manganese, and 3 pounds of puchings. There was 44 pounds of metal in the riser. The metal was of exceptionally good character with very few blow holes; in fact, the casting was so successfully accomplished that it permitted turning and shaping V thread without showing any external effects.

It is difficult to imagine any more severe test of the efficiency of the thermit welding process than is shown in this specific instance. The crusher spindle is subjected to severe bending and torsional strains, and is also subject to shock, the character of the load being more or less intermittent and widely varying in its character. Practically all of the breaks in crusher spindles of this kind are due to crystallization superinduced by fatigue. On October 21 the shaft had been in practically constant operation for two weeks with perfect satisfaction, the portable dryer and heater for the aggregate crusher not having been spared in any way; and to all intents and purposes the repair thus effected will last indefinitely.

The Peru Concrete Bridge in the Eastern Flood

By Daniel B. Luten

The Wayne street bridge at Peru, Indiana, was erected in 1905, and consists of seven spans 75 to 100 feet each, with a roadway 30 feet wide at about 30 feet above low water. The piers are but 6 feet thick at springings, and the arches are balanced to permit complete submersion. The location of the bridge is shown in the illustration at the foot of this page, the photograph from which it was made being taken from a water tower in the city of Peru. That city is situated on the north bank of the Wabash river, and the view includes the town of South Peru on the other side.

In 1907 a flood occurred as shown at its maximum in the illustration at the top of page 273. The approaches to the bridge were submerged, but the water lacked about 8 feet of reaching the level of the roadway over the bridge. This flood established the high water record for a 50-year period. The Easter flood of March, 1913, however, broke all previous records in Indiana and Ohio and proved the most destructive flood that has ever visited Peru. Newspaper reports regarding the situation were greatly exaggerated, but while the loss of life was small, probably not exceeding ten lives lost, the property loss was very great. Almost all of the residences in Peru and most of the business houses were flooded on their lower floors, from one to ten feet, and even second stories in South Peru did not escape.

The flood reached its maximum stage on Wednesday forenoon, March 26, at that time standing approximately at the coping line or roadway level of the Wayne street bridge. In the illustration on this page may be seen the tracks of the C. & O. R. R. on the north bank of the river which were submerged at the Wayne street approach to a depth of 10 feet. This railway crosses the Wabash river about 1,000 feet above the concrete bridge, on a deck girder bridge of five spans, having only two-thirds the length of the concrete bridge and with the top of rail approximately two feet lower than the roadway of the concrete bridge. From top of rail to bottom of girder was approximately 11 feet.

Mr. Guy Roach of South Peru was marooned on the roof of the fifth house below the concrete bridge until Tuesday night. At that time, according to his statement, the arches of the concrete bridge were just barely full, while the C. & O. R. R. deck girder was completely overtopped by the flood. Nevertheless the C. & O. bridge outlived the flood, although its 9 feet of steel girders were opposed for 24 hours to the full force of a current too swift for rowboats. This seems conclusive evidence that flood pressures are not serious, and that no material head is occasioned by a slight constriction of waterway, for in this case 40 per cent of the waterway was blocked by this steel girder bridge in a flood carrying houses, dead elephants and circus tents (from Wallace Brothers' circus located immediately above), trees and cornstalks. Yet a deck girder on concrete piers opposed to this flood to a depth of 9 feet in five 90-foot spans was not even moved from its bearings. It was, of course, impossible to approach closely enough to this bridge to determine what head was occasioned by the obstruction.

On Wednesday morning the lumber in the yard of the Miami Lumber Company, located between these two bridges, was carried away by the flood and lodged against the concrete bridge. This bridge was at that time submerged to its copings and held the lumber floating on the surface of the flood. A hasty examination frightened some of the citizens into believing that the city would be further flooded by this supposed damming of the channel. This led to a proposal to blow up the bridge and newspaper reports from Wabash stated erroneously that the bridge had been dynamited. An examination by the county engineer, however, showed that the lumber was merely floating on the surface and was causing no obstruction to flow.

CONCRETE BRIDGE CARRYING WAYNE STREET, PERU, INDIANA, ACROSS THE WABASH RIVER—VIEW DOWN STREAM—SOUTH PERU ON FURTHER BANK.

WAYNE STREET BRIDGE AT PERU IN THE 1907 FLOOD—LOOKING UP STREAM

As the flood receded the lumber jam began to pass through the arches, but its escape was then prevented by the lumber company, which promptly secured it with ropes to the bridge to prevent it from floating down stream. On Tuesday morning, April 1, the bridge presented the appearance shown in the illustration at the bottom of this page, the flood having receded until its depth was about six feet. Measurements taken to high water signs above and below the concrete bridge show that the flood crest reached substantially the same height above the natural bed of the river at all points in Peru below the C. &. O. R. R. bridge, with no damming or diverting of flood waters at any time by the concrete bridge.

Part of the lumber escaping around the ends of the Wayne street bridge lodged against the Broadway steel bridge, which immediately collapsed, carrying with it the through plate girder bridge of the Indiana Union Traction Company and resulting in a loss of approximately $50,000. The wrecked steel bridges may be seen in the distance in the illustration at the foot of this page.

A horse that escaped from Wallace Brothers' circus swam to the concrete bridge, where it gained a footing and for three days paced back and forth from end to end of the bridge, unable to escape because of the flooded approaches. But aside from this horse and the lumber salvage the bridge cannot be charged either with destroying or saving lives or property, and it is now the only means of communication across the river at Peru and the only highway bridge remaining standing along 30 miles of the Wabash river.

WAYNE STREET BRIDGE, PERU, IND., AS IT APPEARED ON TUESDAY MORNING, APRIL 1, 1913, AFTER THE EASTERN FLOOD.

Reinforced Concrete Stand Pipe at Belton, Texas

By Thomas L. Fountain, C. E.

For many years, the water supply of Belton has been obtained from deep wells, storage and pressure for domestic purposes being secured by use of a steel stand pipe located on a hill in the northern part of the city. The pressure thus afforded not being sufficient for satisfactory service to Baylor Female College, located on one of the highest points in the city limits, the height of the stand pipe was increased about 30 feet. Several years ago the upper half of this standpipe was torn off by the wind, probably due to the weakness of the plates, which originally were near the top. The pressure and storage afforded by the lower half of the standpipe were so unsatisfactory that a bond issue for extending the mains to the south side of the city and erecting a new standpipe on a hill located there carried without opposition.

The chemical contents of the well water at Belton is such that it rapidly corrodes steel, but has no deleterious effect on concrete. The cement mortar coat on the interior of the storage basin at the pumping plant is as sound as when put on 20 years ago, whereas service pipes and fittings all over the city deteriorate rapidly. On this account estimates for the proposed new stand pipe were secured on the basis of using much thicker steel plates than would ordinarily be required. No bids were taken, but the lowest quotation received for a steel standpipe 24 feet in diameter and 75 feet high was over $7,000. At this juncture the firm of which the writer is a member was employed to prepare plans for the proposed waterworks improvements. Believing that a reinforced concrete standpipe could be constructed at a lower first cost which would last indefinitely without any expense for maintenance or repairs, the design shown in Fig. 1 was submitted to the city, and, upon its approval, work was immediately commenced.

Design. In the design of this standpipe, certain assumptions were made which resulted in securing its construction at a cost very much less than for a steel standpipe of the same dimensions. However, since its completion, important facts bearing upon the design of the concrete standpipes have been brought out by Mr. Hyram B. Andrews in a paper read by him at a meeting of the Boston Society of Civil Engineers. Had the design been carried out in accordance with his recommendations, the cost would have been nearly as great as for a steel standpipe. A wall thickness of 14 inches was decided upon, as a result of a study of concrete standpipe, previously constructed, this thickness being ample to transmit the stress to the reinforcing steel and to secure imperviousness with the concrete proportions used. The working stress assumed for the steel was 16,000 pounds per square inch. No mechanical bond was used to fasten the bars to each other. They were lapped 36 inches and bound in position with wire. Laps in adjacent rings were not allowed to come in the same vertical line.

When next designing a reinforced standpipe, it is the writer's intention to follow closely the lines laid down by Mr. Andrews in the paper mentioned above, the most important of which are briefly as follows: (1) The use of a very rich mixture of concrete, (2) a thickness of wall sufficient of itself to prevent the rupture of the concrete when the standpipe is full, (3) vertical reinforcement between the base and walls to distribute the bending moment and shearing stress, (4) a steel dam at each horizontal joint, in addition to the usual "keyings" to prevent seepage.

It is of fundamental importance that a standpipe designed and constructed on the assumption that the tensile stress is to be carried by the concrete alone with the reinforcing bars added as a guaranty of safety, should be allowed to stand at least 60 days after completion before being filled so that the concrete can secure its full tensile strength.

The ornamental cornice and other decorative work at the top and base of the standpipe were added to relieve the severe lines of the structure, as the standpipe occupies the crest of the highest hill in the vicinity and can be seen for many miles. As may be seen from the photograph, it has a much more dignified and interesting appearance than a plain cylinder of steel. No manhole is provided in the wall near the base as in a steel standpipe, as the construction difficulties of furnishing such an opening are hard to overcome for a concrete standpipe. The 8-inch inlet pipe is brought up through the bottom for the same reason.

Construction Equipment. The steel forms for the outside of the standpipe were made from the drawing shown in Fig. 2. Two complete rings were used in order that one might be assembled on top of the other without waiting for the concrete to acquire a hard set, and to secure a better bond at the joints by pouring fresh concrete on that still "green." The cost of these forms delivered at Belton was $423.

The concrete was mixed in a 3-cubic-foot batch Smith hand mixer, which discharged into a steel elevator bucket of the same capacity, arranged to run in vertical guides and to dump automatically into a combined bin and chute set above the working platform. The bucket was hoisted by a team, used for other purposes when the pouring was not in progress. The wheelbarrows used in placing the concrete were filled by opening a wooden gate at the lower end of the bin. The outside scaffolding was made of 3-inch by 10-inch discarded bridge flooring cross braced with 1-inch by 8-inch ship lap. As shown in Fig. 3 it was erected in sections as the work progressed.

The inside working platform was supported on double rows of 3-inch by 8-inch joists projecting radially from a short central post to which they were rigidly attached. Each pair of floor joists was separated by wooden blocks allowing the 4-inch by 4-inch vertical guide and support studs to pass between them. These studs were set back 2½ feet from the inside of the wall to give room for the wheelbarrows. The only inside flooring was that laid between these studs and the wall. The stud joints were mitered and fastened with bolts. Six feet below the working platform a similar arrangement of joists supported the wooden inside forms, which were made up in sections 6 feet high, or double that of a single set of outside forms. Each of these systems of floor joists was supported by iron pins set in holes bored in the vertical studs at any level required.

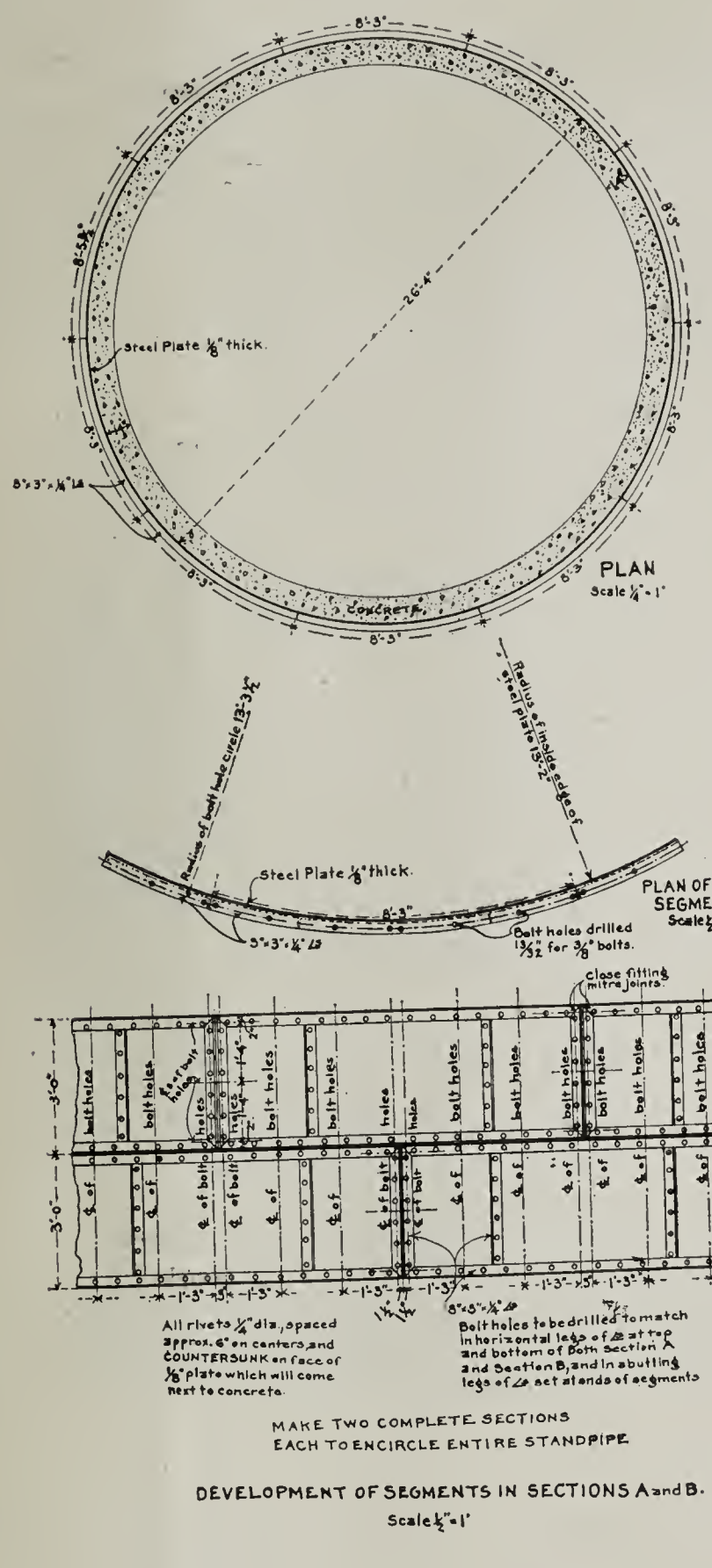
Method of Construction. Excavation for the foundation revealed rather soft rock at the depth originally determined upon for the bottom of the standpipe and wall footings. The excavation for the wall footings was therefore deepened four feet, stopping on solid

rock. The concrete for the wall foundation was poured to within about one foot of the lower side of the bottom of the standpipe. The remainder of the wall foundation and the bottom were next placed at one pouring. Keys were left for the walls as shown in Fig. 1. During this pouring 1-foot lengths of 1¼-inch pipe, threaded on the upper end and provided with sleeves, were set vertically around the periphery in the soft concrete.

The steel forms shown in Fig. 2 were used for the outside of the thicker wall at the base as well as for the remainder of the vertical shell. The increase in the circumference required for the first 6 feet from the bottom was obtained by bolting the plates in each ring against vertical wood spreaders.

The 1¼-inch pipes used for supports for the reinforcing bars came upon the ground cut into sections of the exact length shown in Fig. 1, threaded and drilled. Each 6-foot section was screwed into place as it was reached with the concrete.

The reinforcing bars were bent to the approximate curvature required before hoisting them to position. At each vertical pipe each bar was spaced and held by passing a wire through the ¼-inch holes in the pipe and around the bar. When the work on the walls was first started, only one three-foot section of concrete could be poured in two days on account of the large amount of reinforcing steel which had to be placed. After a height of 24 feet was reached a three-foot section was poured each day. When the pouring of a section once started, it was finished regardless of the time required, the work frequently running well into the night on account of the difficulties encountered in raising the inside platform. Each pouring of a three-foot section required about three hours, 9 cubic yards of concrete being placed in that time. The concrete was mixed soft but not sloppy and was distributed in wheelbarrows in layers 12 inches thick, care being taken to equalize the pressure against the forms by uniform distribution. As soon as each pouring of a three-foot section was finished large V-shaped wooden keys were placed in the soft concrete. Before the pouring of another section was begun these keys were removed, the whole exposed surface of the concrete



was wire brushed and washed, and the space occupied by the key filled to overflowing with 1:2 mortar.

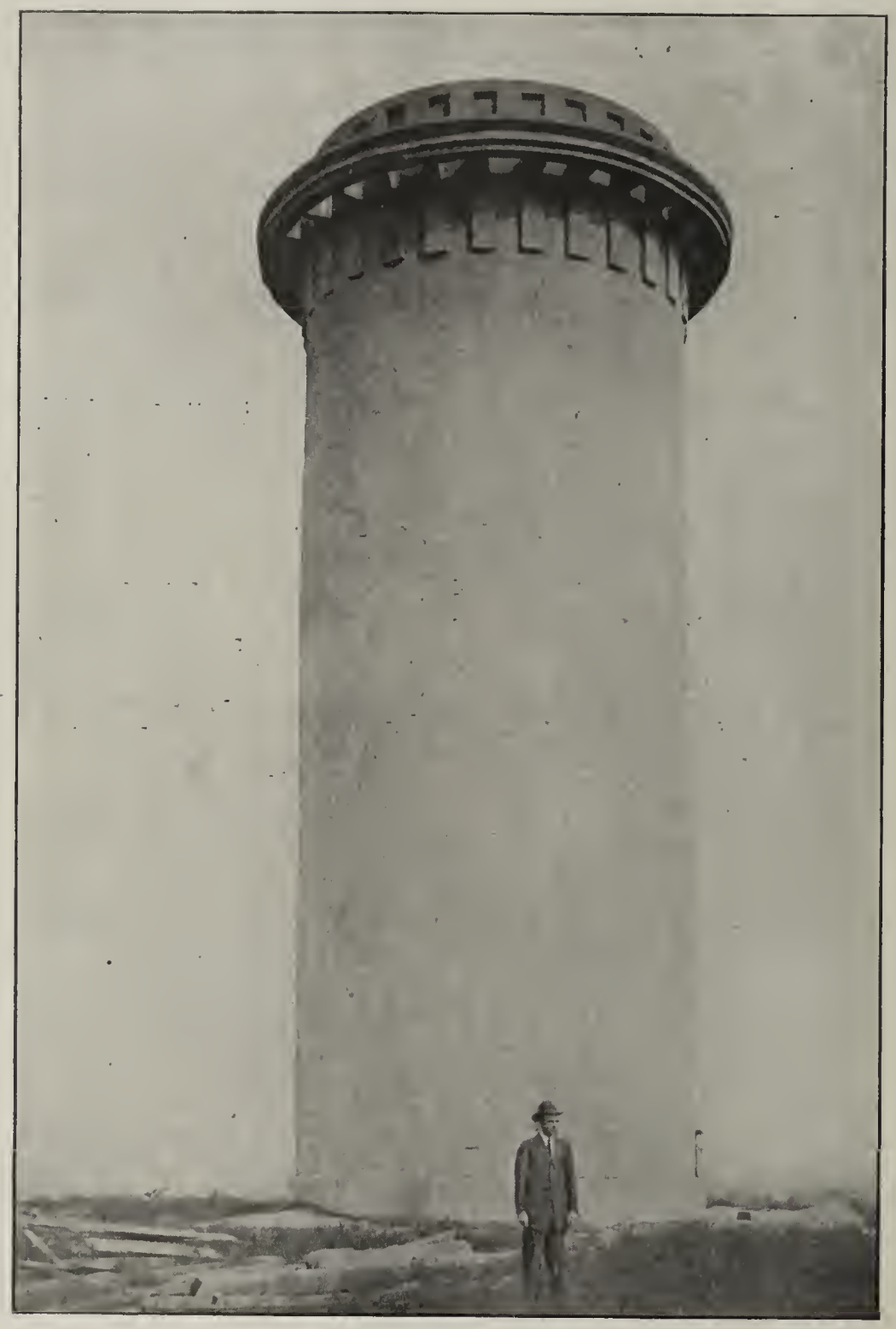
As soon as the inside forms for each six-foot section were removed, the inside wall was thoroughly wet and painted with a thick neat cement grout.

Since the center of the standpipe was occupied by the joint produced by the abutting radial floor joists, the walls were kept vertical by a center secured through the use of a 30-inch wooden circular disk the exact size of a circle drawn upon and concentric with the concrete bottom of the standpipe. Three corresponding points 120 degrees apart were set on the disk and circle. The disk was then set in approximate position and adjusted accurately by shifting until plumb bobs dropped from the three points were directly above the corresponding points on the circle below. In order to dampen the plumb bob swing without hiding the three points on the floor circle, glass tumblers filled with water were placed over them.

The entire cornice and brackets are monolithic. The forms for this part of the work were supported on the tops of the outside verticals which were cut off at the proper height for this purpose. The tablets below the cornice were moulded on the ground, hoisted to position, and grouted into recesses left in the wall.

The construction force consisted of one foreman, one carpenter with two helpers, one driver with team, and seven laborers. After the completion of the standpipe the outside was scraped, washed and painted with cement grout mixed with sufficient sand to make it spread readily. When the standpipe was first filled some leakage occurred, due to the development of fine vertical cracks in the concrete as the steel elongated under its working stress. This leakage has gradually decreased, until at present it is an immeasurable quantity. The total cost of the standpipe was $6,000, $500 of which amount was spent upon the cornice and ornamental work.

Concrete. The gravel and sand used for the concrete occur mixed in the same bank which is located about two miles from the standpipe. The sand varies from rather fine to coarse. In order to secure as dense a concrete as possible for the amount of cement used, sufficient fine sand from a sand pocket in the gravel pit was added to fill the voids in the unscreened mixture of combined gravel and sand. Cement was then added to the proportions of 1 part of cement to 6.33 parts of the aggregate, the entire proportion being as follows: 1 part cement, 2.4 parts coarse sand, 3.6 parts gravel, 0.33 parts fine sand. All gravel and sand particles passing through a ⅜-inch mesh inclined screen were classed as coarse sand. The resulting concrete was very rich in appearance. Cut into some time after the erection of the standpipe, it was found to be hard and dense.



The standpipe complete, showing ornamental cornice and other decorative work on top.

Three Forks Portland Cement Mill

Gallatin, Madison and Jefferson rivers come together in the western part of Gallatin county, Montana, constituting the trident of streams that forms the Missouri river. About a mile below the confluence of those three, at the very beginning of the Missouri Valley, is Trident station of the Northern Pacific. Here the banks of the river are low, the valley is level, and half a mile wide. The right-hand bluff, as you go down stream, is made up of extensive deposits of limestone and shale clay. This mass runs 75 per cent carbonate of lime and 25 per cent in aluminates and silicates. These constituent elements, and the relative proportions in which they occur, determined the location here of the plant of the Three Forks Portland Cement Company. The picture accompanying this article gives a view of the works where 1,600 barrels of "Red Devil," Portland cement, are turned out daily. The raw material no doubt comes as close to the proper cement mix as occurs anywhere in nature. The only material not obtained on the ground is gypsum, which is hauled in from near Whitehall. But gypsum is not an element that enters into the composition of cement proper; it is added in the amount of 2 per cent to 3 per cent after the cement clinker has been formed, and it serves to regulate the set, and acts as a retarder.

MONTANA'S FIRST PORTLAND CEMENT MANUFACTURING ESTABLISHMENT.

Three Forks Portland Cement Company. Lindhardt Kominuters, manufactured by F. L. Smidth & Co., 50 Church St., are used for grinding raw material, and Smidth Ball and Tube Mills are used on the finished grinding. The two kilns, each 150x9½ feet, were furnished by Vulcan Iron Works, Wilkes-Barre, Pa., who also furnished the dryer, which is 120 feet long by 8½ feet in diameter.

The face of the quarry, as now opened, is about 400 feet in length and 50 to 60 feet in height. Preparatory to blasting down the rock, tunnels are driven in, and short cross-cuts are made therefrom. Ingersoll-Rand air-drills are used for underground work. Two 2-yard steam shovels are used in loading the broken rock into bottom-dump 2-yard rock cars, the car track extending from the bins at the crusher building to the quarry. Six to seven dump cars are hauled back and forth by a donkey engine, delivering about 600 tons of rock to the crusher bins daily. The crusher building contains a No. 8 Gates gyratory crusher, a revolving screen and a No. 5 Gates crusher, made by Allis-Chalmers Company, Milwaukee, Wis. The rock all passes through larger crusher, thence to the screen; and the oversize from the screen is recrushed by the smaller crusher. The crushed material is conveyed by a chain-bucket carrier, which runs on a track at an incline of 45 degrees, to the six-story sampling mill. It is delivered to a belt conveyor by which it is discharged into any one of eight bins which hold 1,000 barrels each. As the material is being conveyed to the sampler bins an automatic sampler cuts out 5 per cent of it; and in like manner other samples are taken until the bulk is reduced to the final sample for the laboratory. The material is pulled from the sampler bins to a belt conveyor, thence over automatic weighers, is delivered to the pit of an elevator, and by the latter raised to the top of the building and discharged into a gas heated cylindrical dryer 120 feet long by 8½ feet in diameter, made by Vulcan Iron Works, Wilkes-Barre, Pa. It discharges from the dryer and is carried by a chain-bucket elevator to the main mill building and delivered into bins from which it is fed to the Smidth kominutors of which there are five. These kominutors are made by F. L. Smith & Co., Nw York. The oversize is returned for further grinding; the pulverized or undersized product drops to a screw conveyor, and is taken thence by elevator to bins from which it is fed to fine tube mills, 5 to 22 feet, containing cylpebs, or steel slugs, and flint pebbles. The tube mills complete the second and final stake of raw grinding, giving a product which passes for the most part through No. 200 sieve. It is now ready for burning to "clinker" and is fed to the revolving kilns. There are two of these kilns, each 150 feet long by 9½ feet in diameter. While the pulp is fed into the head end of the kiln, the pulverized coal is blown in at the opposite end, having been ground to a fine powder in Fuller mills.

The product of the kilns, Portland cement clinker, is carried by conveyor and elevator to the cooling cylinder, in which it is aerated by stirring arms. When sufficiently cool it starts upon the 2-stage finish grind-

ing process, going first through another group of Smidth kominutors, thence through the tube mills and by conveyor to the stock room as finished Portland cement. The gypsum is added between the first and second stages of clinker grinding. There are large compartments for clinker storage, prior to grinding in the kominutors. A long tunnel under this storage provides connections with the finish end of the mill by means of chutes and belt conveyors, from which the clinker is taken by elevators to the bins above the kominutors.

The stock building, lately erected, is of solid cement, and holds 50,000 barrels. The company has a well-equipped machine shop, and keeps in stock duplicate parts of machinery, which amounts to an investment of $50,000. All the mill and shop machinery is driven by electric motors, of which there are thirty, of from 15 to 250 horsepower, each. Power is derived from two different power plants, transmission lines from which connect with these works.

The company has a hotel and dining room and public hall, and twenty-five cottages for employees on that part of the site between the railroad and the river. Water is supplied by a pumping station on the river, which lifts it to a stand pipe, from which it is distributed.

O. B. Gilson is general manager for the company, Helmuth Krarup being superintendent of the plant; W. H. Andrews is chief chemist, and W. E. Burke is sales manager. This product is everywhere regarded as up to the highest standard; it passes the autoclave test. The material is analyzed four times before reaching the kilns to assure a perfect mixture. That the company is doing a good business in Montana and adjoining states is evidence that speaks for itself.

"SPECIFIC CEMENT CONTRACTS"

"A Specific Contract" is a phrase which is interesting to both dealer and manufacturer today. In years gone by, contracts, like charity, covered a multitude of sins. This, however, is the day of modern business, of fair play, of intelligent understandings between manufacturer and dealer. As a natural consequence, the "unspecific or padded contract" must go. Every transaction must be open and regular, clean and fair, giving manufacturer, dealer and consumer a livable margin; in short, a contract satisfactory to all concerned.

For a period of ten or twelve years, following the introduction of Portland cement manufacturing in this country, the demand far exceeded the supply—accordingly high prices prevailed. During the winter months when the lowest levels were reached, the dealer would contract for his year's requirements. As the season opened prices would advance, permitting the dealer to dispose of his purchases at a good profit. Those were the good old days.

However, as more mills were erected, the supply of Portland cement was soon greatly increased.

What happened then to the dealer with all his yearly contracts? Business conditions were not good, the effects of the 1893 panic were still felt. Prices on cement were lower than his contract. The dealer very naturally turned to the manufacturer to try to cancel his contract. In this he succeeded.

The next year the manufacturers' salesman appeared. He said it was sure to be a big year. High prices would follow, etc. The dealer figured he would take a chance again. If prices did advance he was safe. If they went down he would cancel his contract. The first of March or April was reached. The manufacturer in listing his contracts figured two-thirds of his year's output was sold, and advanced his prices so as not to be oversold. Prices were therefore advanced not on account of demand but simply because of a lot of paper contracts. About the middle of the year stock houses were full, building was light and down went the price of cement. Again the manufacturer held the bag. The dealer, too, was in hot water. The retail prices he was forced to make resembled an enlarged record of a seismograph, following the motions of the San Francisco earthquake. This situation continued for three or four years, when the manufacturers decided to make contracts requiring all year or extended deliveries for specific building operations only, believing that this policy would destroy speculation and put the investment in general on a more sound basis, where supply and demand alone would regulate prices. The manufacturer's idea was fine, but he reckoned without his salesmen. From this time on, the most ingenious, inventive, dexterous and juggling efforts were conjured up by the salesman—the most impossible and improbable forms of construction and building were invented, covered by an all-year contract with the dealer. If a job required 1,000 barrels it was written for 3,000.

As a result no two dealers in the same town were buying for the same price. If the market went down below the contract figure the manufacturer sometimes insisted on the dealer taking in the full amount of his contract at the contract price. It is needless to say that in such cases no further business was transacted between that particular dealer and manufacturer. If one dealer in a town had an unspecific contract and another dealer had none, the manufacturer whom the second dealer was representing, growing dissatisfied with the tonnage he was receiving, would proceed to open things up by disregarding the dealers and selling direct to the contractor and the consumer.

Up to the last year or two, these practices have prevailed generally. The manufacturer was alone to blame for them.

However, present day business methods applying in all other forms of manufacturers' commodities have forced themselves into the cement industry. The manufacturers now appreciate that the dealers do not want such loose contracts and are willing in all instances to stamp out such evils, provided they know and feel that they will be able to buy as cheaply as their competitors; on the other hand, the dealers themselves realize that specific contracts are a necessity. With specific contracts lived up to by both manufacturer and dealer, prices will take care of themselves. No trade agreements or associations can possibly maintain prices above their true level—the level regulated by supply and demand. Odious, unfair and unprincipled methods, however, such as unspecific and padded contracts, for which the manufacturer and his salesmen alone were responsible, can lower and depress the true value or price of any commodity to the extreme detriment and loss of all concerned.—[Lehigh Portland Cement Company, February Bulletin.]

KOSMOS CEMENT MILL

Andrew Cowan & Co., agents for the Dodge Manufacturing Company, at Louisville, Ky., have received an order from the Kosmos Portland Cement Company, Kosmosdale, Ky., for a large quantity of Dodge Standard split iron pulleys, flange couplings, shafting, etc.

CONCRETE PILE TRESTLES

Throughout the West and the South it is still the general practice in railroad construction to use timber or pile trestles for bridging small streams, ravines, bayous and marshes. But with the increasing cost of timber and the raising of railroad maintenance standards, the replacement of these bridges is being carried out with structures of more permanent character. Where the drainage areas are small, concrete or masonry culverts are often used, and the remaining portions of the old trestles are replaced by an embankment, usually at low cost. But on many roads the river bottoms have often required long pile trestles. Bayous and swamps cannot always be filled, and steel bridges to replace the old structures would be too expensive on account of their great length. These cases, however, require only moderate spans, and for work of this character concrete trestles have recently been used on some of the Western roads.

CONCRETE PILE TRESTLE—CHI., IND. & SO. R. R., SHELBY, IND.

The accompanying pictures show one such trestle, built over the Kankakee river near Shelby, Ind., on the Chicago, Indiana & Southern Railway. This is a single track trestle, 1,056 feet long, divided up into 18-foot panels. The river channel is spanned by a 60-foot steel structure.

The cylindrical Chenoweth piles were driven with a drop hammer, assisted by a water jet, and ranged from 21 feet to 30 feet long. The slabs are 7 feet wide, 18 feet long and 30 inches deep, each weighing approximately twenty-five tons. Two slabs span each opening.

Unfavorable conditions at the bridge site made it impossible to cast these slabs nearby, as the country in the vicinity was under water when work was started. On account of this, both piles and slabs were cast in a yard some distance away, shipped in on cars and lifted into place by means of a derrick car. The reliability shown by these piles in previous work warranted casting the exact number required, in the proper lengths, and driving them all without injury. After driving, concrete caps were cast around the tops of the piles, and after a sufficient period of seasoning, the slabs were set in place. The new structure was built alongside the old trestle and the track at either end shifted to a new alignment. This method of procedure often makes it possible to erect a new trestle from the line of the old, using it as a basis for bringing up materials, and without interruption to regular traffic. The economy of this system is evident.

DERRICK CAR HANDLING SLABS

This work was in charge of R. B. Seymour, chief

engineer, and W. M. Hughes, consulting engineer for the Chicago, Indiana & Southern Railway, and was built by the W. P. Ijams Company of Terre Haute, Indiana, under the management of G. E. Bowman. The American Concrete Company of Chicago furnished the piles. Universal Portland cement was used.

SWINGING PILES INTO POSITION FOR DRIVING

CONCRETE FOR MODERN IRRIGATING SYSTEMS

The advantages of concrete work in irrigation are perhaps almost as widely recognized by the public in general as by engineers. The layman in engineering science knows, for instance, how great a part the use of concrete is playing in the construction of the Panama Canal, and there are probably few readers who have given the subject any attention who are not aware of the use to which concrete has been applied in the construction of the great locks at Panama. In irrigation the value of concrete work has long been recognized. In the construction of the great Roosevelt dam, built under the National Irrigation Act to water the Salt River Valley, the Government erected its own concrete plant. In the Gunnison tunnel in Colorado, in the Truckee-Carson project, and, in fact, in every one of the huge irrigation works constructed by the Government, concrete has made possible the construction of the most advanced types of diverting and impounding dams or of canals, laterals and spillways. In municipal water systems concrete is extensively employed.

In projects under private management concrete is no less favored. Its resistance to the action of the weather, to heat and to the influence of water renders it a most desirable material for use in extensive projects. After once set it makes an imponderable head gate. No one could wish for a finer example of the use of concrete in irrigation than that afforded by the Government irrigation works in Nevada, where the concrete is subjected to great extremes in climate. No other material lends itself so readily to rapid construction, and with none other is it possible to gain at a minimum expense so finished and artistic an appearance.

In the irrigation work to be embraced within the fully completed Natoma irrigation system the use of concrete will undoubtedly play an important part says the Natomas Consolidated of California, Sacramento, Calif., producer of crushed rock. For this purpose Natomas' crushed rock is especially fitted, and with an abundance of this material at hand Natomas Consolidated of California is equipped to economically outfit its irrigation systems with the most advanced types of concrete construction. The "three-eighths to dust" rock produced by Natomas crushers at Oroville, Natoma and Fair Oaks, California, is used to an extent in concrete work, although the ¾-inch size is more commonly used in reinforced concrete construction. All four sizes of Natomas rock, however, "dust to ⅜-inch," "¾-inch," "1½-inch" and "2½-inch" are used in road building, street building and concrete work.

When not used in massive form concrete contracts and expands according to the weather, and allowance should be made.

CEMENT CO. REORGANIZATION

According to official advices from Philadelphia, the plan of reorganization for the Atlantic & Gulf Portland Cement Company formulated by the reorganization committee has been adopted by the holders of all deposited first mortgage bonds. The plan provides for the formation of a new company which will issue $500,000 first mortgage 6 per cent thirty-year gold bonds, with privilege to issue $100,000 additional for additions to plant. Special scrip bearing 6 per cent interest will be issued to all holders of first mortgage bonds of the old company participating in the plan. All scrip must be redeemed before the declaration of any dividends of the new company's stock of any class. There will also be issued $1,500,000 7 per cent first preferred stock and $200,000 non-cumulative 6 per cent second preferred stock, subject to redemption at option of the company.

CONCRETE IRRIGATING PIPE AT THE STATE FARM

A BRIDGE WHICH WITHSTOOD THE FLOOD

A concrete arch bridge of five spans, of 85 to 110 feet each, was erected over the White River at Waverly, Indiana, in 1911, by the National Concrete Company of Indianapolis. The bridge is of Luten design and cost $38,000. It was designed and erected for the Board of Commissioners of Morgan county, Indiana, competing successfully in cost with steel bridge designs considered at the same letting.

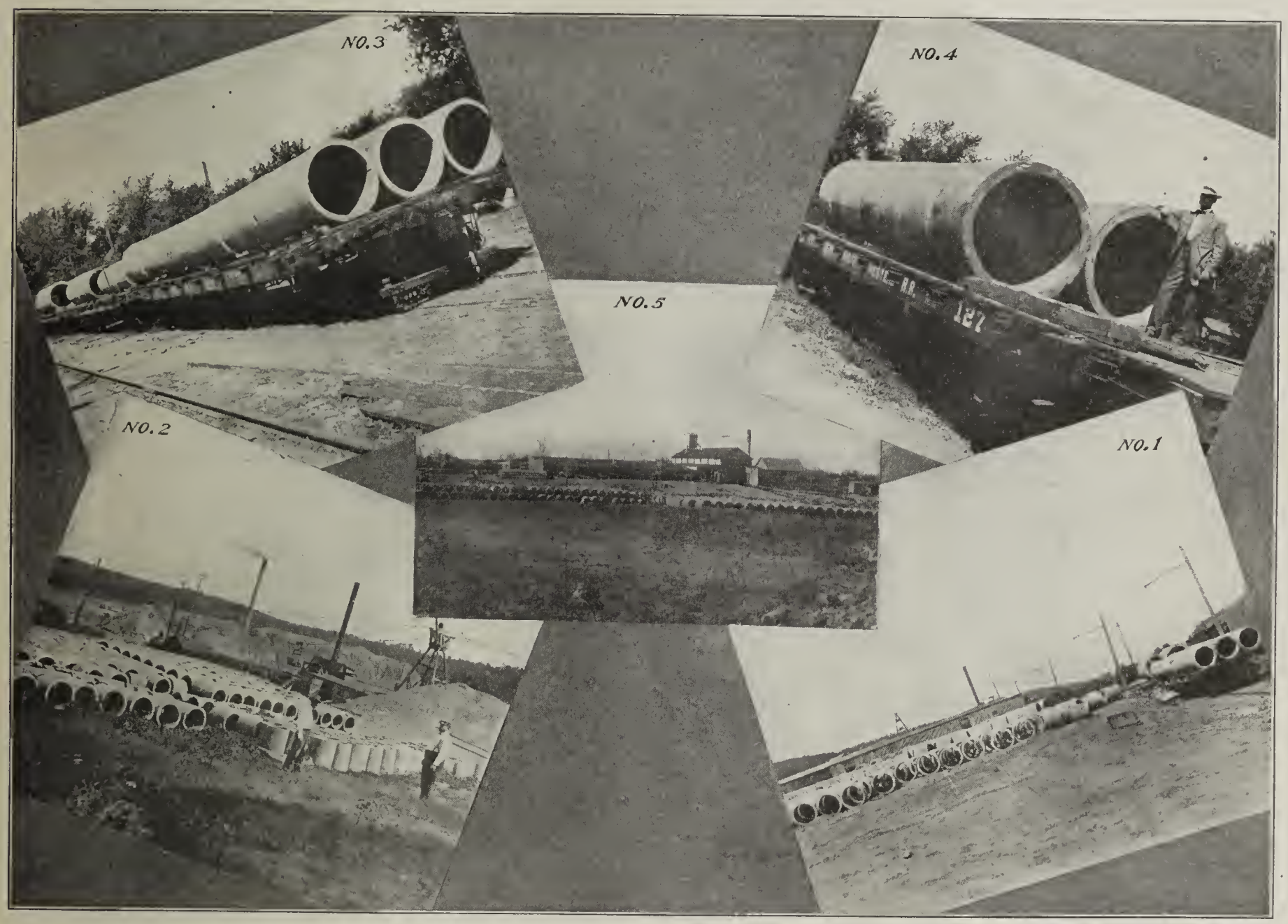
This bridge was subjected to the full force of the Easter flood of March 23-27, 1913, but escaped injury. The bridge is located about twenty miles below Indianapolis, in which city the same White river completely destroyed three steel bridges and seriously damaged four others. Every steel highway bridge across the river in Indianapolis was put out of service by the flood. All concrete arch bridges over White river in Indianapolis, four in number, passed through the flood with no damage.

This remarkable superiority of concrete over steel in flood resistance was to have been expected, however, for in addition to the greater weight opposed to the flood by the concrete bridge, the arch is claimed to be the most favorable form of waterway for flood discharge. The center of flood pressure is lower in an arched waterway and the hydraulic radius greater. Hence for the same area of waterway the discharge will be greater for the arch. The arch always leaves some opening for passage of debris, except when the crown of the arch is completely submerged, and even then the only obstruction is the slight thickness of the arch ring as compared with the entire submerged depth of the truss or girder bridge across the entire stream.

The obstruction to flow caused by the haunches of the arches tends to produce a cushion or fender of dead water at the surface only, that diverts debris into the swift channel at center of arch. If it were not for this fender of dead water at the surface the current would carry debris with equal velocity against the piers.

If the flood level could always be kept below the lower clearance line of the truss or girder bridge, the arch would be at a disadvantage, but when an unusual flood occurs, such as this Easter flood, the crest must rise above the floor of many bridges, endangering them by lodgment of debris. Yet it is for the unusual floods that bridges should be designed, rather than for freshets. The behavior of the concrete arch bridges in the vicinity of Indianapolis has taught their great superiority for all flood conditions.

SOME LARGE CEMENT TILE AND TILE PLANTS



A Few Views of Large Tile Made on the National Cement Tile Machine and Plants Where They Were Made. No. 1—Tile plant and yard of a very successful plant in Central Iowa. No. 2—Another view of the same plant. No. 3—36-inch Cement Tile ready to be unloaded and hauled to the ditch, shipped from Plant No. 1. No. 4—Some large tile, 34 inches in diameter, weight of each tile 1700 pounds. No. 5—Another successful plant in Northern Iowa, using two National machines.

AWARDED THE GRAND PRIX

Ceresit waterproofing has just been awarded the Grand Prix at the World's Fair held this year at Ghent, Belgium.

GREAT OUTPUT OF LIME

Production for 1912 More Than Three and a Half Million Tons.

Figures obtained by the United States Geological Survey from the producers of lime throughout the country show that in 1912 the demand for lime was greater than ever before and that the resulting production was the largest in the history of the industry. The total production of lime in 1912 was 3,529,462 short tons, valued at $13,970,114, as compared with 3,392,915 short tons, valued at $13,689,054 in 1911, an increase of 136,547 short tons in quantity and $281,060 in value.

The total number of plants operating in 1912 was 1,018, as compared with 1,139 in 1911. This decrease in the number of producers was due in large part to the inactivity of small kilns operated by farmers for burning lime for local use as a soil sweetener and in part to the tendency of the industry toward concentrating plants into fewer and larger units. The heaviest decrease in the number of producers was in Pennsylvania, a State in which it has been a common practice for many years for farmers to burn small quantities of limestone quarried on their own farms for private use, and this large decrease is due almost wholly to the farmers' later practice of buying their lime already burned and to their use of fertilizer in preference to lime.

The five leading states in 1912 were, in the order of production, Pennsylvania, Ohio, Wisconsin, West Virginia, and Maine. Maine has supplanted Missouri, which occupied fifth place in 1911. Pennsylvania, which has long held first rank in both the quantity and the value of lime produced, in 1912 made a total output of 849,159 short tons, valued at $2,679,420.

The uses to which lime is put are many. The quanity of building lime used in 1912 was 1,556,446 short tons, which exceeded that of 1911 by 67,879 tons, but that the value, $6,571,479, was $184,410 less than the value in 1911. There was a slight increase in the use of lime by chemical works, paper mills, and tanneries, but a decrease in its use in sugar factories. The use of lime in fertilizers also increased, the figures for 1912 being 604,607, valued at $1,852,530, compared with 596,664 short tons, valued at $1,714,386, in 1911. This increase in the use of lime on the land may perhaps be attributed in part to the tendency in recent years of city people to go back to the farm or to take up agricultural pursuits on a scientific basis.

Lime is also used as a plant food; it has been the common practice for farmers in some part of the country to spread it upon the fields and plow it under in order to sweeten the soil. The use of lime renders available the plant food already contained in the soil.

A copy of the report may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

Over 2,000,000 concrete blocks have been used so far in the new $10,000,000 plant of the Minnesota Steel Company, at New Duluth, Minn. The Company is now about to start the construction of 200 concrete block houses and 65 apartment buildings, each to accommodate six families. The plans which have been prepared by Dean & Dean, Architects, Chicago, call for block walls and monolithic floors. Considerably over 100,000 barrels of Universal Portland cement has been used in the new buildings of the Minnesota Steel Company.

CONCRETE ROADS

The Organization Committee of the Lincoln Highway Association, whose headquarters are in Detroit, Michigan, have issued a folder outlining the aims and purposes of the Organization. In its statement of objects is the following: "To immediately promote and procure the establishment of a continuous improved highway from the Atlantic to the Pacific, open to lawful traffic of all descripton without toll; and to be of concrete wherever practicable."

The last clause in the statement is a significant recognition of concrete for highway building. As the Lincoln Memorial Highway movement has its center in Detroit it is not surprising that the Organization should have introduced such a clause in favor of concrete. Detroit has become famous the world over for the wonderful concrete country roads that have been built in Wayne County radiating from Detroit.

The Association has committed itself to the permanent improvement of approximately 2,000 miles of the transcontinental road. As a **permanent** road concrete fulfills every requirement. The economy and durability of this type of road is rapidly becoming appreciated the country over.

The Chicago Evening Post printed the following: "Wayne County voted several years ago to bond the county for $2,000,000 with which to construct good roads and as a result some of the finest roads in the world have been built radiating from Detroit. This spring there remained unissued $250,000 in bonds, the proceeds of which were to be used in finishing up the work. But as the bonds pay only 4 per cent and investors were looking for a larger return the commissioners found it impossible to dispose of the bonds through the ordinary channels.

When the commission was about to give up work because of a lack of funds, Mr. Couzens, who, in addition to his activity in the Ford Company, is president of the Detroit Board of Commerce, stepped in and took the entire issue to assure the completion of the road work this year."

This is significant indication of the satisfaction which the concrete roads of Wayne County are giving. About seventy-five miles of concrete roads are to be completed all of concrete. Several hundred thousand barrels of Universal Portland Cement have been used thus far in their construction.

CONCRETE FACTORY BUILDING

A large plant is now under construction at Asbestos, Maryland, for the Baltimore Asbestos Roofing and Manufacturing Company, who are removing their plant from Oil City, Pa. It is essential to have an absolutely dry building and plans were drawn by John B. Hamme of York, Pa., for hollow tile but after thorough investigation by the officers of the company it was decided as a matter of economy and permanency to use the Redman concrete hollow wall system for the exterior walls, patented by W. T. Redman, Brentwood, Maryland.

The walls will be 12 inches thick, with 4-inch air space, and reinforced with 8-inch "I" beams cast upright in the walls which will serve to carry the roof girders.

Asbestos roofing of the company's own manufacture will be used.

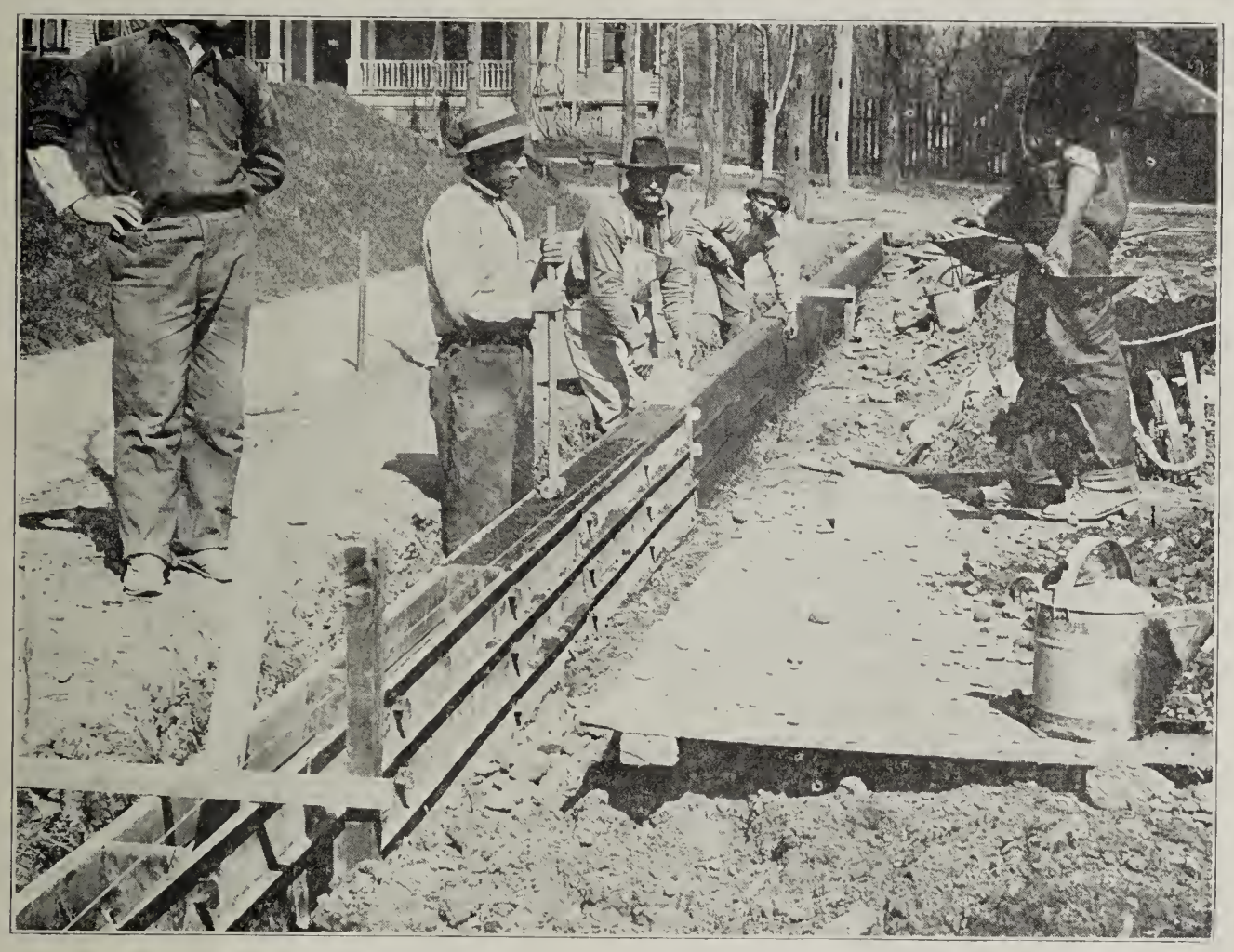
The entire plant will be 54 by 800 feet, but will be built in units of 200, 300 and 300 feet respectively as required for the installation of the machinery.

STEEL FORMS FOR CONSTRUCTING CONCRETE SIDEWALK, CURB AND GUTTER

No type of concrete construction is better adapted for the use of steel forms than concrete sidewalk, curb and combined curb and gutter. Although steel forms are more expensive than wood in first cost, their advantages are so many that they are now being used to a large extent in work of this sort. One of the more interesting designs of steel forms now on the market is that of the Hotchkiss Lock Metal Form Company of Binghamton, N. Y. This form consists of rigid or flexible side rails, division plates and wedge-shaped keys or lugs for fastening these parts together. The division plate holds the side pieces in place, thus making the form self-sustaining and self-bracing. The rigid sides are commonly 10 feet long and have slots at 1-foot intervals to receive the division plates. They have a flange at top and bottom to keep them rigid and in use are joined end to end by a tongue and socket. These rails are also made in 4-foot and 6-foot lengths. The flexible side rails have no flanges. They are made of spring steel and may be bent to any desired curve.

The recommended method of constructing sidewalks with these forms is about as follows: At least 50 feet of the forms are connected up in place, and the concrete placed in the first block. The grader starts at work leveling the concrete so that after it is tamped it will come within ½ inch or 1 inch of the top of the forms. Behind the grader follows the tamper, tamping the whole concrete surface firmly, taking pains to tamp next to the side-rails and the division plates. The concrete should have been mixed middling stiff. While this work is being done another part of the gang should have been mixing the top. This, too, should be mixed middling stiff, with just enough water so that when it is tamped firmly into the concrete base there will be enough moisture come to the top to finish nicely. Here is another tamper at work on the top. Following him are two men striking off, and close on the strike-off is the finisher floating and edging, which is also done immediately without any waiting for a puddled surface to dry out. Immediately after the walk is edged, the keys are knocked out of the side-rails, and the rails passed on to the front, the plates removed and the points grooved.

The Hotchkiss Company also manufacturers a steel curb and gutter form. (Write Dept. O, Binghamton, N. Y., for circular.) This consists of steel templates which conform in shape to the finished curb and gutter. To serve as molds for the back of the curb and front of the gutter are provided steel channels, which are slotted at regular intervals. On the front and back of the template are tongues, which pass through these slots and are locked there by lugs on the outside. When set up this way they form a rigid and substantial form that will stand alone and which does not need any stakes or braces. The cut shows a section of curb in course of construction with these forms.



VIEW OF CONCRETE CURB IN COURSE OF CONSTRUCTION WITH HOTCHKISS METAL FORMS

The illustration shows a portion of the completed curb, the forms in position on another portion, and the division piece in process of removal.

THE OLDEST CONCRETE SEWER

A. M. Libberton, Assistant Engineer of the Universal Portland Cement Company, Chicago, has written the Dodge Manufacturing Company, Mishawaka, Ind., that when he visited Mishawaka four years ago he located a sewer under the wood pulley shops on Union Street, and after investigation learned it was one of the oldest concrete sewers in existence. He said further that the service it was giving was remarkable in view of the fact that all kinds of materials had been going through it and that the use of the sewer had been much more severe than that ordinarily encountered. He said there was no evidence of deterioration of any kind. Mr. Libberton expects to use the information obtained on this sewer in one of the Universal Portland Cement Company's publications. He secured a picture of the wood pulley shops to go with the article.

Wagon Loaders for Handling Sand, Stone and Gravel

In the Stone Age, men who had need of a quantity of sand or stone, went to the nearest source of supply, filled a sack or skin by hand, slung it on their shoulders and walked back with it. Later some inventive genius constructed wagons or carts, and the more or less round wheels were probably looked upon as the last word in mechanical invention. After awhile a shovel for loading carts was invented, and this combination of carrying in carts and loading by shovels has been in universal use ever since. Railroad cars are carts adapted to long hauls, and automobile trucks have somewhat replaced horse-drawn vehicles, but the loading of these, except in very large operations, is slow and done by hand labor.

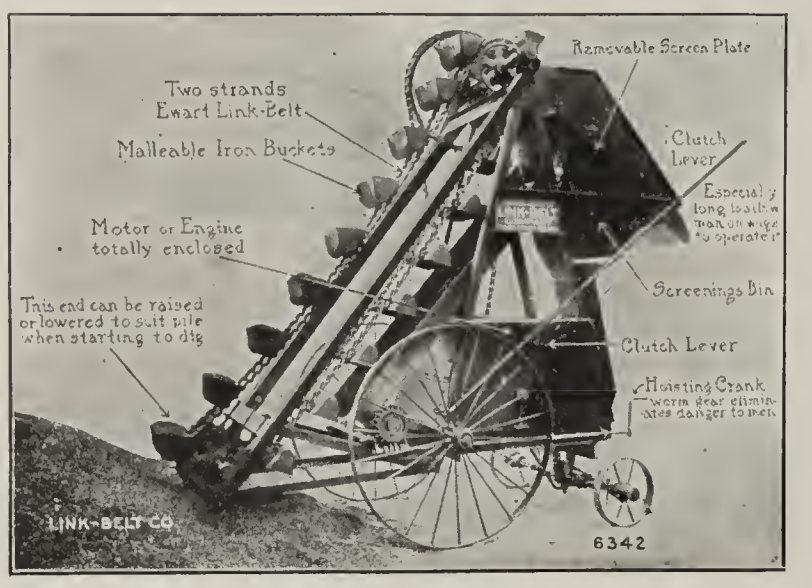


FIG. 1. LINK-BELT PORTABLE LOADING MACHINE FOR RAISING MATERIALS TO WAGONS AND CARS

With the introduction of the steam shovel and the automatic grab bucket, a great advance in speed and economy was made, but the first cost, and difficulty of moving these outfits about, make them economical only where they are used in the same place or moved a moderate distance.

This is the second Stone Age. The tremendous increase of the recent years in the use of sand and stone, due to the growth of concrete work, and the great amount of road building, has caused the handling and rehandling of millions of tons of material, and in nine cases out of ten it has been done in the original shovel and cart way. This is especially true in the case of road building, where the location of the work is constantly changing, making necessary the loading and unloading of all the material used in construction. The unloading has been simplified by the dump cart and self-dumping wagon, but the loading has been done by the same conditions which the ancients used—the man with the shovel. This is hard and exhausting work, and with the constant increase in wages and shortening of the length of the standard working day, has become a large and uneconomical item in the cost of any large piece of work. In these days of close margins and competition, nobody can afford to overlook any department of his business which is capable of improvement along the lines of efficiency; and here, in the loading of carts, we have a source of waste, and a very large one, which is increasing each year by leaps and bounds, in direct proportion to the amount of material to be handled.

For example:—Suppose you have a contract which includes the loading of several thousand tons of sand, stone or gravel from piles on the ground to cars or carts. The pay of the laborers, the cost of transportation in carts, the first cost of material, the unloading of the material from the carts—these are all practically fixed amounts. The cost of loading the material from the storage piles into carts however, is capable of a large reduction. This can be done by the use of an elevator mounted on wheels so as to be readily moved about, and operated by a small motor or gasoline engine. Such a machine is shown in Cut No. 1. It consists essentially of a single strand bucket elevator, with buckets attached at intervals of about 2 feet, the whole mounted on a steel truck with large wheels. The elevator delivers to a chute from which carts are filled. The continuous feature of this elevator makes possible a high capacity, and the short lift uses but little power. For handling gritty materials, a chain is used which has in its joints case-hardened pins and bushings which greatly prolong its life; and for handling material like crushed stone, the buckets are fitted with manganese steel digging teeth or prongs, to prevent the excessive wear caused by the stone. These machines are not "diggers" in the sense that they can be run back into a pile and made to dig it up, but the materials must be trimmed by hand to the foot wheel by one or more men. The machine thus saves the labor of lifting the dead weight from the ground level over the side of the cart, and of course, when handling material such as sized gravel or anything that runs readily, a large amount can be fed to the foot of the machine by cascading or pulling down by shovels. This is especially true in handling hard coal or dry sand, where the angle of flow is fairly flat.

FIG. 2. EQUIPPED WITH ROTARY SCREEN AND ESPECIALLY ADAPTABLE FOR REPAVING WORK

In actual operation, the engine of the machine is started, and a clutch thrown in, which puts the chain and buckets in motion, and the machine is backed into the pile until the buckets strike the material. They will pull through the material as long as it flows by gravity, but finally the buckets will have made for themselves a clear path. The material is then trimmed or fed by men with shovels within reach of the buckets, and it is so much easier for men to push

the material down in this way than to throw by shovel-fulls into the cart, that two men with one of these machines have handled sand at the rate of 40 tons an hour, and one man working on hard coal can handle a ton a minute. Here, then, is the source of economy. By the use of a simple machine, such as outlined above, two or three men can put material into carts at a rate which would require at least ten men if using shovels in the old-time way. In dol-

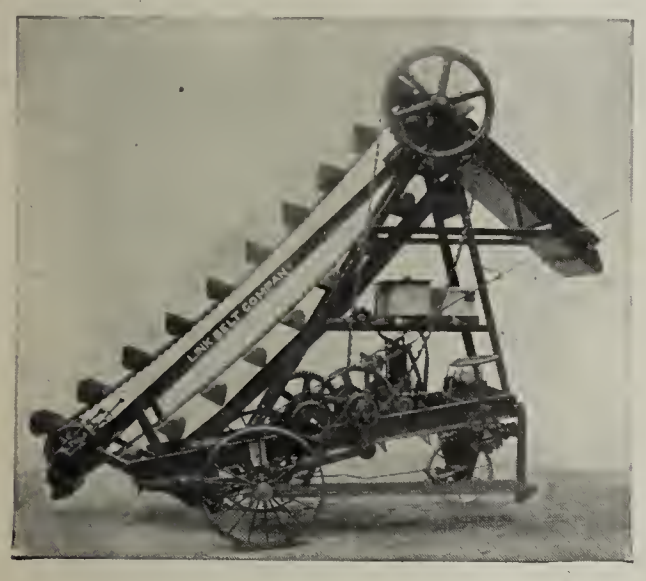


FIG. 3. EQUIPPED WITH BEVEL DRIVE AND STEERING GEAR FOR SELF-PROPULSION

lars and cents it has been proved that a saving of from 5c to 10c a ton can be made in handling materials in any large quantity. From this it is easy to see what a large field there is for this type of machinery, and what a large saving can be effected when the quantity is anything over 20 tons a day. Portable Loaders are also being used by a number of concerns merely to relieve the congestion of their yards, even though the loading is done by the cart drivers who are paid by the purchasers of the sand.

Starting with the original idea of an elevator mounted on wheels, a surprising number of modifications have been made in their use. Cut No. 2 shows one of these. It consists essentially of the addition of a rotary screen at the head of the elevator, delivering screenings to one chute and rejections to another. This type of machine has been used mostly for repaving macadam roads.

The old macadam is plowed up and broken, and fed by a gang of men to the foot of the elevator, which delivers it into the screen. By means of the screen the sand and dirt are taken out and delivered to a wagon on one side, and the rejections of the screen, consisting of screened material of a certain size, are delivered to a wagon on the other side, and can be used over again for the new work. It is very easy to see what a large saving this effects, to produce a clean sized product, right on the scene of operations, ready to use and loaded in wagons.

Another modification of these machines is shown in Cut No. 3. On this type, driving gear has been added to make the machine self-propelled in either direction. The operator stands on the running board at the head of the frame, with his starting and stopping levers, steering gear and engine control, all within easy reach. The advantage, of course, of the self-propelled type is in traveling short distances, and in moving from one bin to another where several kinds of material have to be handled. The capacity of all of these types of machines is about 50 tons an hour, but this, of course, can be very easily increased or cut down by changes in the size of the buckets. In actual practice, while the buckets have a theoretical capacity of 50 tons an hour, the amount of material delivered into the wagon by the machine depends entirely on the uniformity with which the material is trimmed or fed to the machine, and this is largely a matter of practice with the trimmers.

Cut No. 4 shows another form of machine designed for handling sand. The elevator is made slightly steeper, and the spout at the head is pivoted so that it can discharge in front, or on either side of the machine. This feature makes for speed. In a case like the one shown in the cut, a car can be run to one side of the machine and be filled, and in the meantime another car placed in position at the far side.

The spout is rotated through 180 degrees, which delivers the supply at once to the second car, eliminating practically all waiting for cars. The elevator shown in the cut was installed in a sand bank of 40 or 50 feet in height, and on account of the soft nature of the ground was operated on planking. A large amount of material, however, can be trimmed down the bank without moving the machine. When the angle of repose of the sand is about reached, 2 or 3 feet is cleared away from in front of the wheels, and 2 or 3 planks are laid, on which to roll the machine back within reach of the bank.

From the fact that most sand or gravel banks and sand piles are remote from the source of electric current, a majority of these machines are equipped with gasoline engines. The engines are similar to those used on agricultural and farming machinery, and are fitted with a magneto which saves all trouble with batteries, and also a governor to keep the speed within limits. The load on the elevator is of course constantly varying, and the use of the governor prevents any racing of the engine at periods of light load.

Cut No. 5 shows one of the most successful applications of the portable loader. This machine is being used on a contract calling for several miles of concrete road bed, 20 feet wide and 6 inches thick. The stone and sand are deposited by carts in piles as shown, at intervals of about 200 yards. The concrete is mixed in a portable mixer, and the value of a wagon loader here is in the speed with which the wheel barrows can be loaded for filling the mixer. The loader

FIG. 4. LINK-BELT MACHINE FOR LOADING SAND

was fitted with a special chute and gate for filling the barrows, and the chute has a capacity of several barrow loads of stone. One or two men can keep the hopper full, and when a man wants a barrow load of stone he can get it in less than five seconds. The foreman in charge of this work states that from his previous experience in road building, he estimates that

three men and this machine replace a force of ten men, which he has had to have for this operation on all his former work. The upper chute on this loader is of course used for filling wagons, and is put in operation by the closing of the gate leading to the wheelbarrow storage hopper. The location of the stone and sand piles, and the quantities in them, are calculated to keep just ahead of the finished road-bed, and when one pile is used up, the mixer and loader are pulled by horses to the next stone pile.

Another very successful application of the wagon loader is in quarries, where there are no storage pockets. Stone can be stored in the fall and winter, and at a very small proportional cost it may be reloaded into carts and wagons for shipment at the height of the season. Most quarries find a ready market for all the stone they can produce in the summer, and it is a well known fact that larger quantities of this material could be sold if the producers stored the stone in large piles. Heretofore, because of the high cost of moving these piles, it was not considered wise to make storage piles. With the portable wagon loader, however, these large piles are now moved with the minimum of expense and at a good profit.

While a great many portable wagon loaders are in successful daily operation handling stone, sand, gravel, coal, earth, pyrites, etc., their general use for loading materials is only in its infancy. With the increased difficulties of securing efficient common labor, employers are finding it profitable to use modern labor-saving machinery. The wagon loader will not "go on strikes" or "lay off" on special holidays, etc. Teamsters, as a rule, are well pleased with the loading machines, as they are relieved of the work of shoveling into wagons. All the wagon loaders described in this article were manufactured by the Link-Belt Company of Philadelphia.

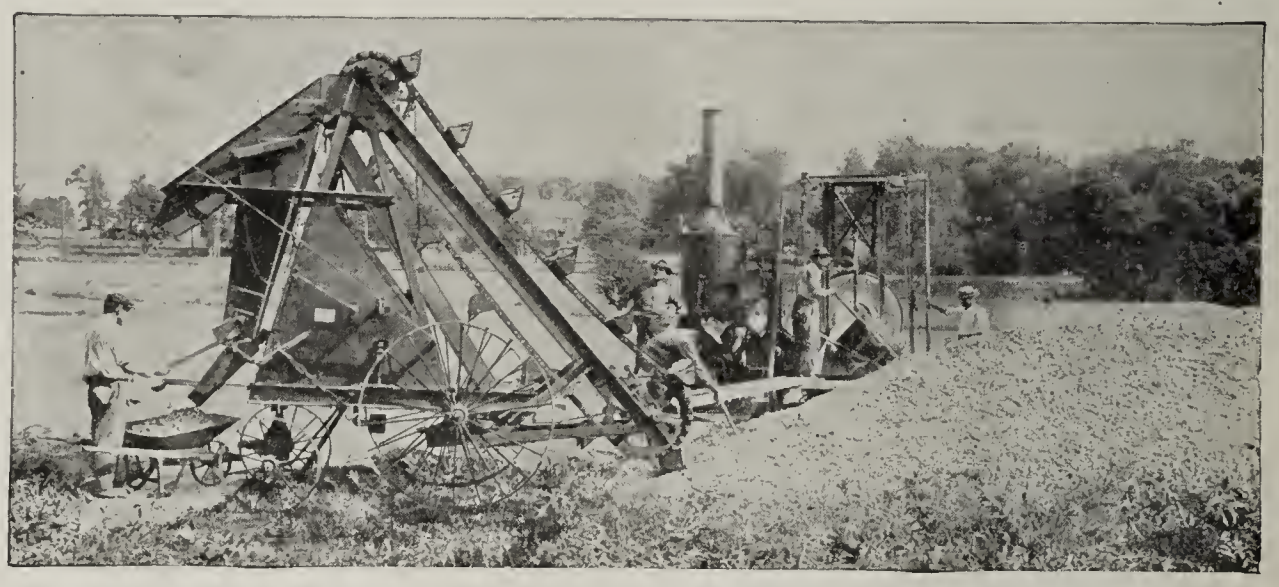


FIG. 5. LOADER IN USE ON CONCRETE PAVEMENT WORK EQUIPPED WITH TWO CHUTES, THE UPPER FOR WAGON-FILLING, THE LOWER FOR WHEELBARROWS

NEW PAMPHLETS ISSUED

Small Motors No. 16 issued by the Industrial and Power Department of the Westinghouse Electric and Manufacturing Company has just made its appearance. This issue is devoted to the subject of electric motor driven washing machines. A number of interesting views of this popular household device are shown together with a description of the various types of washing machines, and arguments to central stations in favor of handling Westinghouse motor driven devices of this kind. A list of the manufacturers of small motor driven devices, and electric vehicles is also included therein.

Westinghouse electrical equipments for automobiles and garages is the title of a small pamphlet (folder 4223) issued by the Westinghouse Electric and Manufacturing Company. This folder describes the Westinghouse 6-volt, single wire, starting, lighting and ignition systems developed by that company. Accessories, including meters, rectifiers, vulcanizers, etc., are described.

Westinghouse Three-Inch Meters is the title of a little pamphlet (4254) just issued by the Westinghouse Electric and Manufacturing Company describing the different meters having an overall dimension as indicated in the title. These meters are adapted for automobile battery equipments. They may be obtained in flush and round types. A particular feature is the black painted dial which is said to entirely eliminate the glare present on white dial meters when same are illuminated.

Type CS Squirrel Cage Induction Motors for constant speed service are fully described and illustrated in descriptive leaflet No. 2321 just issued by the Westinghouse Electric and Manufacturing Company.

CONCRETE MACHINERY

Under a comprehensive title, "Concrete Machinery," W. E. Dunn Manufacturing Company, 4139 Fillmore street, Chicago, Illinois, is sending to the trade one of the most informative catalogs of concrete machinery and appliances yet published. It contains accurate descriptive matter regarding the following inclusive list of machines long used and approved by concrete product manufacturers all over the country:

Dunn No. 1 Drain Tile Machine; Heavy Duty Drain Tile Machine; Utility Mixer; Poured Sewer Pipe and Tile Molds; Combination Block Machine; Wet Process Brick Machine; Ornamental Molds; Porch Mold Outfits; Pier and Chimney Molds, 8 inches high; Pier and Chimney Molds, 4 inches high; Adjustable Molds; Lattice Molds; Vase Molds; Silo and Block Molds; Ball and Baluster Molds; Adjustable Cores; Chicago Gasoline Engines.

The expanatory showing of tile making machinery is unusually complete and full of interest for the products manufacturer who sees the drainage propaganda spread over his territory rapidly while the matter dealing with block machines and molds for various products as well as with the well-known Dunn brick machines is thorough and full of valuable information. The book is an excellent piece of business literature, well illustrated with pictures that tell a real story and it will prove to be a valuable acquisition to the library of any concrete worker.

THE LENTZ STEAM ENGINE

A Reciprocating Engine Using Superheated Steam

By Siegfried Rosenzweig.

The use of superheated steam in engines greatly reduces the initial condensation in the cylinder, and the leakage past the valves and piston. High superheats should be used in order to obtain the highest economy in operation. The author in his own experience has found that a superheat of from 200 to 250 deg. F. is commercially practicable and gives excellent working results. The higher initial cost for installing superheaters is easily counterbalanced by savings due to the use of smaller piping and boilers with less heating surface, etc.

Early experiments with superheated steam in engines were disappointing in their results, due largely to the use of valves which were not suitable for the high temperatures employed. The balanced multiple-seated poppet valve (see Fig. 2) has been successfully used for this work. It has no rubbing surfaces—hence lubrication is not required, its wear is negligible, and it is well adapted to use with high temperatures. Being of small weight and well balanced, high speeds and high steam pressures may be employed.

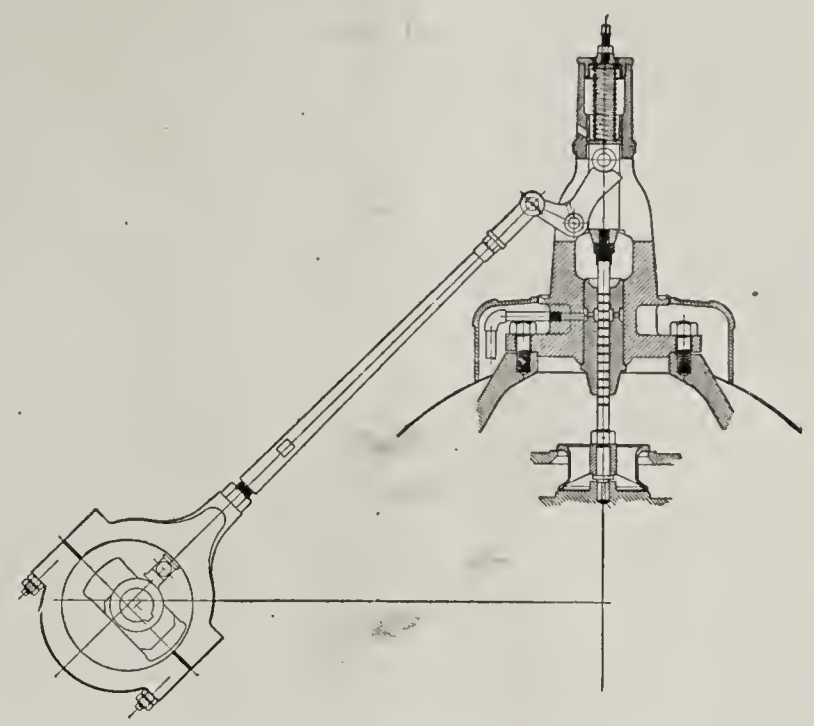
The Lentz engine is a reciprocating engine that has to a certain extent revolutionized modern steam engine design. More than 3,000,000 H. P. of these engines have been built in sizes up to 10,000 H. P.

Fig. 1 shows the valve-gear side of a tandem compound engine of this type. A lay shaft runs alongside the engine, and is driven by the crank shaft through bevel gears. Each valve is operated by its own eccentric, and these eccentrics are keyed on the lay shaft. The different valves are thus entirely independent of each other and can be set accurately according to the requirements of steam distribution.

Fig. 2 shows the different parts of the internal valve gear: the valve, grooved valve spindle, spindle guide with roller, and cam lever. All pins, bushings, rollers and cams are case-hardened in order to prevent wear. Normally, the two faces of the poppet valve rest on their seats in the cylinder and prevent the flow of steam from the steam chest into the cylinder. Admission and cut-off are effected by breaking and re-establishing the contact of the valve faces and seats. The valve is balanced, except for the width of the seats (not over ⅛-inch even in larger sizes), and little power is required to operate it. The opening is effected rapidly, and the whole movement is positive and noiseless, no dashpots being used. Speeds up to 350 r. p. m. have been successfully used. No valve spindle packing is used, the spindles being simply ground in cast iron bushes and provided with grooves, thus producing a labyrinth system in which the condensed steam and oil collect and by which the escape of any steam is successfully prevented.

A similar principle is used for the piston rod packing, which is made entirely of cast iron rings but so arranged as to follow the floating action of the piston rod.

The low-pressure cylinder is placed next to the bed. This arrangement allows the high pressure cylinder to expand freely without being obstructed by the distance piece and the low-pressure cylinder. The opening in the distance piece is made large enough to remove the back cover and piston of the low-pressure cylinder without disturbing the alignment of the engine.

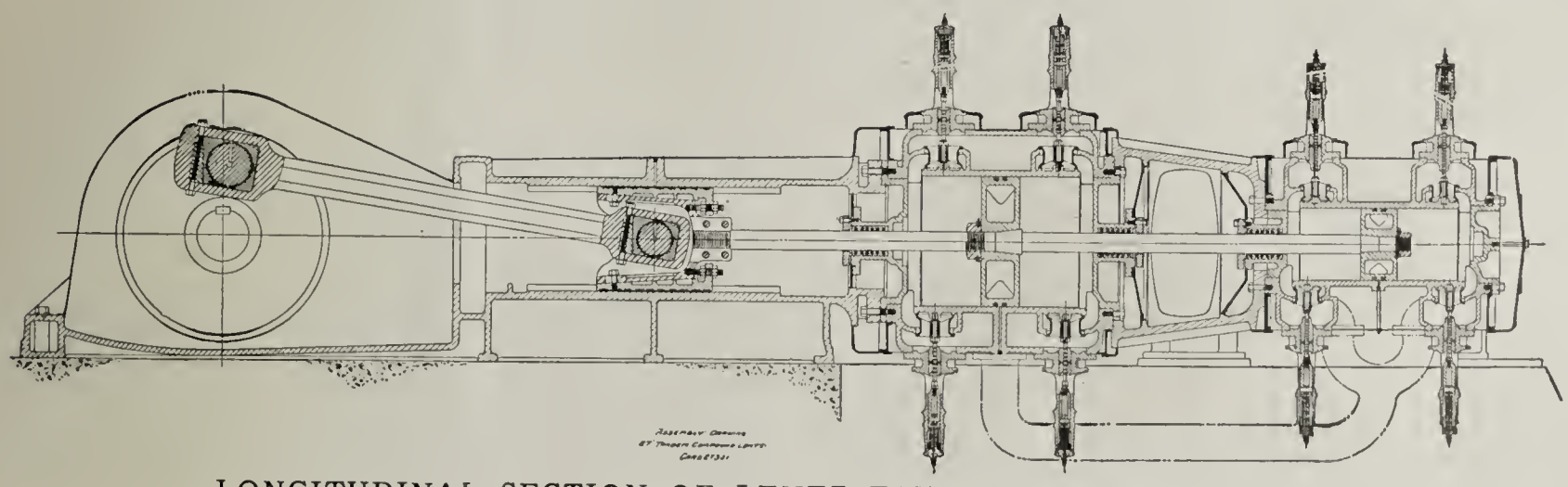


SECTION THROUGH VALVE

All the low-pressure and high-pressure exhaust valves are driven from fixed eccentrics, the high-pressure inlet valves only being influenced by the governor.

Fig. 2 shows also the arrangement of the high-pressure steam eccentric. This eccentric is arranged to slide on a block which is keyed to the shaft. When the load changes, the governor slides the eccentric on the block and alters the angular advance and the throw of the eccentric according to the requirements of the load, while the linear lead remains constant.

The governor is located between the two steam eccentrics and alters their position without the use of belts or chains. It consists of two pendulums pivoted to a support which is keyed on the shaft. By means of links the pendulums are connected to the governor's inertia body which can move freely around the shaft, being connected with the shaft only by a flat circular spring which counterbalances the centrifugal forces of the pendulums. The potential energy stored up in the inertia body is converted into kinetic energy of motion as soon as the slightest change of load (and consequently of speed) occurs.



LONGITUDINAL SECTION OF LENTZ TANDEM COMPOUND ENGINE

As the inertia forces and the centrifugal forces act in the same sense, their combination produces a governor of a very sensitive and instantaneous action.

It is possible to change the speed of the engine while in motion by means of a radial pin which presses against the governor spring and changes its tension. This pin is moved by means of a shaft and hand wheel at the end of the lay shaft.

Extensive tests have been carried out on a Lentz simple engine having a 15-inch diameter cylinder and 21-inch stroke. This engine showed a steam consumption of 19.2 lb. per I. H. P. per hour with an average steam pressure of 145 lb. gage, an average superheat of 47 degrees F., and a back pressure exhaust of 2 lb. This performance gives a Rankine efficiency of practically 76 per cent.

A tandem compound engine carefully tested gave the following results. The first test with saturated steam, 170 lb. gage boiler pressure, and 26 in. vacuum, gave 366 I. H. P. with a steam consumption of 12.3 lb. per I. H. P.-hour. The second test, with the same conditions as before but with superheated steam of 150 degrees F. showed a steam consumption of 10.4 lb. per I. H. P. per hour. These results were obtained from an entirely new engine within two days of first running.

The Lentz semi-fixed engine, a combination of an engine with boiler, superheater, condenser, air pump, feed-water heater and feed pump, is a compact, high-class and self-contained power plant which is extensively used in isolated plants in Europe and South America. On account of its compact arrangement and the absence of any piping and losses incurred by it, the economy of these engines is remarkable. Tests by Prof. Grassmann, of the Technical College of Carlsruhe, Germany, of a 200-H. P. unit showed a steam consumption of 7.4 lb. and a coal consumption of 0.92 lb. per B. H. P., figures which probably stand as world records. The mechanical efficiency of the engine was 93 per cent and the combined efficiency of boiler and superheater 82 per cent.

THE NEGLEY PATENTED EXCAVATOR

The Negley Patented Excavator is a revelation in the excavating machinery world. It was invented and patented by Mr. Claude E. Negley of Indianapolis, Indiana.

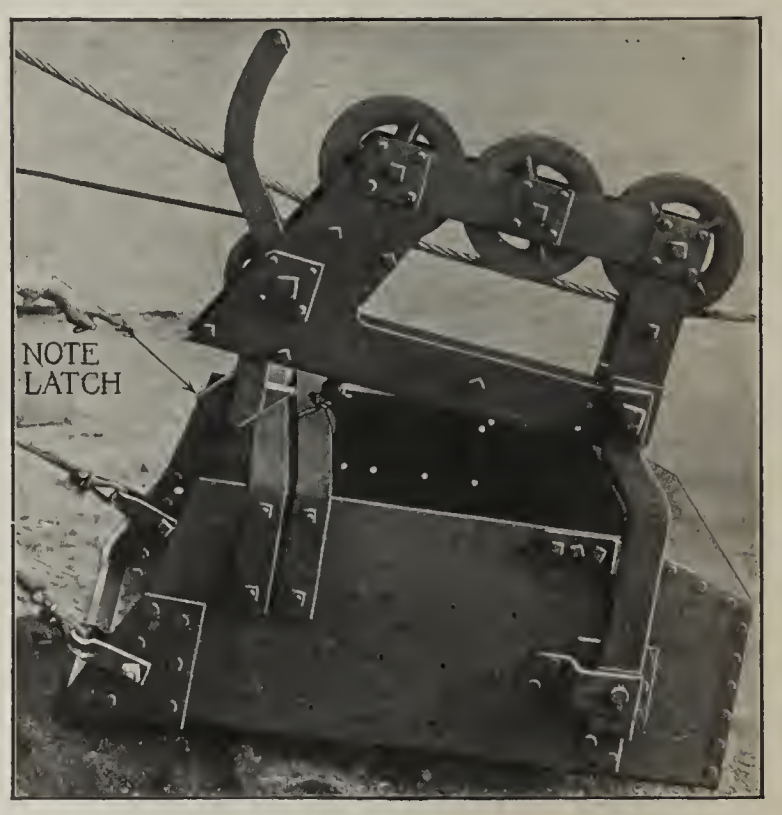
Mr. Negley was for years in the sand and gravel business, coming in personal contact with the frequent troubles that are a part of the business, he saw the importance of removing them. Necessity being the mother of invention, all that was required was a study of the causes of these effects, with a little inventive genius, to develop for the market an excavator second to none for efficiency, economy and durability.

This excavator is constructed compact and strong, with very few wearing parts, all of which are reinforced, while the carrier stands erect over the bucket in a rigid manner, assuring a durable, economical and rapid working machine, adaptable to all uses for a cableway excavator.

It is operated upon a slack cableway, with a two-drum friction hoisting engine, the front drum operating the load line, which controls the loading, transmission and dumping. The rear drum operates the tension line, which by means of fall blocks, connected to the main cable, controls the raising and lowering of the excavator.

The latch, or locking device, which is the most important feature, is so constructed that it will not fail to engage and hold the load. It is balanced so that it retains the engaged position at all times, except when it is disengaged by contact with the stop on the main cable. At the will of the operator the load may be discharged as fast or slow as the demands may require. This double dumping feature is not possible with other cableway excavators and as it assists wonderfully in quick operation, it is responsible in a large way for the productive ability of the machine.

The latch line, which works in conjunction with the latch, is another feature that deserves mention. This line is connected to the front of the bucket and passes over a sheave in the carrier and is fastened to the load line. In the loading of the excavator this line is slack, the stress being on the load bails, when the bucket is loaded and the excavator starts to raise, the weight of the load is taken by the latch, automatically the load bails are slackened and the latch line becomes tight and performs the duty of conveying or transmission. When the arms of the latch come in contact with the stop, the latch is disengaged and the latch line takes up the load, holding



NEGLEY PATENTED EXCAVATOR

the carrier in position until the load is discharged, accomplishing the operation without additional strain on the main cable.

Another very important feature of this excavator is, that it only requires three and one-half feet for clearance and will dump closer to the mast than other machines of this type. These are very decided virtues.

Another important feature, in the construction of this excavator, is the exclusive adoption of cable, which is stronger, lighter and more economical than any other appliance.

There seems to be every reason to believe that this is an excavator, destined for a long and useful life. The Indianapolis Cable Excavator Company, New York street and Beauty avenue, Indianapolis, Indiana, are offering this excavator at a reasonable figure, and invite the most rigid investigation.

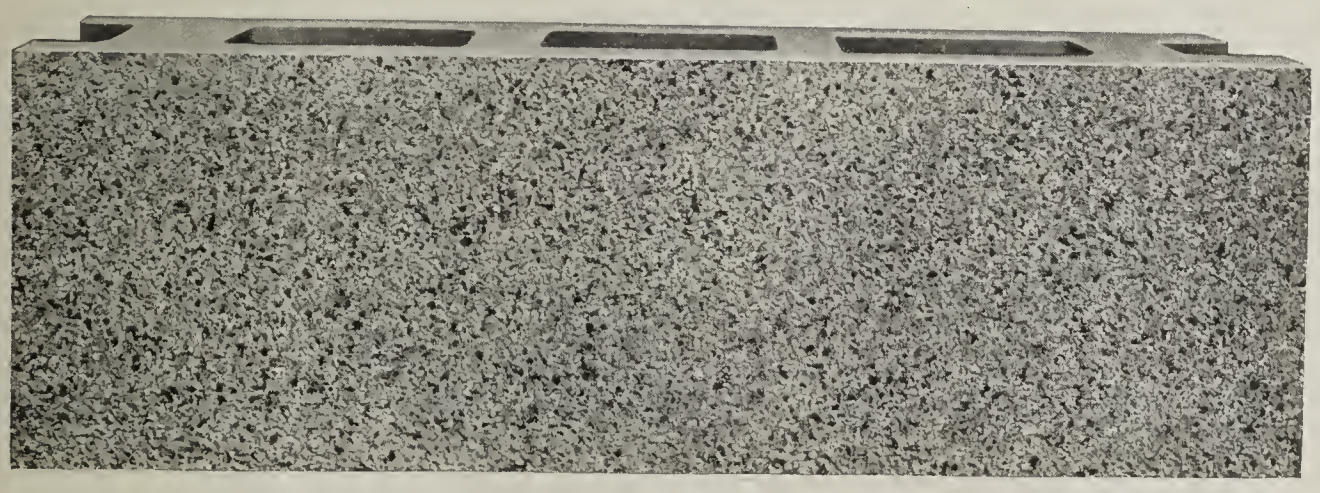
THE NEW EQUITABLE BUILDING

The new Equitable Life Insurance Building in New York, 38 stories high, will contain approximately 36,000 tons of structural steel, the inspection of which, both mill and shop, has been intrusted to Robert W. Hunt & Co. of Chicago, New York and Pittsburg.

GRANITE VENEER BLOCKS

It has been the dream of all block makers, ever since block making began, to be able to face a cement block in an attractive manner and at a price in proportion to the cost of the rest of the block. The Zagelmeyer granite veneer block has solved this problem beyond the fondest hopes of every one. The body of the block is made by the well known Zagelmeyer cast stone system which has been in very successful operation for over five years and is universally acknowledged by all, to be the only system which produces a perfect cement block. The process of veneering these blocks with crushed granite is the crowning feature of this splendid system and the product is the last word in cement blocks. The term veneer is not used figuratively but expresses exactly the result of this process, as nothing but the genuine granite shows on the face; it is therefore not an imitation, but a cement block actually veneered with pure granite and is precisely as good as though the entire block was made of granite.

ENLARGED VIEW. SMOOTH FACED GRANITE BLOCK



8X8X24 INCH GRANITE SMOOTH FACE BLOCK

A glance at the photographic reproductions herewith shows the perfection of our process. The grains of granite which make up the facing, lie so close together that no cement can be seen and the outer surface is entirely free from cement and nothing but the granite crystals show, while the back of them are embeded in neat cement, holding them like diamonds in a setting, writes the Zagelmeyer Cast Stone Block Machinery Company, 90 Crump avenue, Bay City, Michigan.

To produce this granite veneer we first coat a face plate with thin glue, then cover the plate with crushed granite. By turning the plate over all particles that do not adhere drop off, the plate is then set away until the glue hardens, this takes about one hour. The molds are then set up in the usual way but just before the molds are filled, the granite crystals that are now firmly held on the face plates by the hardened glue, are given a coating of pure cement mixed with water to the consistency of a thin paste. This coating is applied with a brush. The purpose of this coating is to embed the crystals in a layer of pure cement.

The molds are then filled with slush concrete and left to harden. While the cement is setting, the water from the wet concrete softens the glue and the blocks when taken from the molds are just as you see them in the illustrations.

The only purpose of the glue, is to hold the crystals in place and to protect one side of them from cement, while the block is being cast.

The glue all comes away from the face plates in granular form and three or four strokes with a wire brush cleans the plates ready for the next coating of glue. The entire operation is so simple and the result so wonderful that it seems like magic.

Feeble attempts have been made to produce granite and other natural stone faces by using acids to eat away the cement. Attempts have also been made to obtain the desired result by spraying before the cement has set; these methods, however, are expensive and the results obtained are not at all satisfactory.

The granite crystals we use for veneering these blocks are furnished by the Crown Point Spar Company, 663 Broadway, New York City, from their quarries at Crown Point on the Hudson river, N. Y. The blocks can be veneered with practically any kind of crushed rock, but the granite crystals above mentioned are by far the handsomest for this purpose of any rock that has come to our notice. As one ton of granite will veneer about three thousand 8x24-inch blocks, this granite can be used for veneering blocks on our system in nearly all parts of the United States. The Crown Point Spar Company ship this granite in one hundred pound bags in any quantity from one bag up.

We will be pleased to send a sample granite veneered block to any address in the United States, to any one who will agree to pay the freight on same, when it arrives. The weight of the block, packed for shipment, is about 100 pounds. You can easily find out how much the freight will amount to, to your city, by asking your local freight agent.

These blocks are cheaper to make than ordinary dry-tamped blocks with sand facing. They cannot be made on the dry tamped system and the process can only be used in making cast blocks. We have patents pending in this and foreign countries, thoroughly covering and protecting this new process. Secure this system for your city, before your territory has been secured by your competitor and you will have a very profitable business that no one can take away from you.

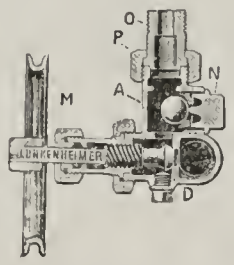
We are operating a model plant in the City of Detroit with a capacity of two hundred 24-inch blocks per day. We extend a cordial invitation to everybody to visit it. We believe we are turning cement into blocks at a less price at this factory, than any other factory in the world, and the blocks are not equaled, either in looks or quality any where else at any price. If you doubt it, investigate.

Unless you already have a catalog, send for one.

IMPROVED AUTOMATIC WATER GAUGE

The Improved Automatic Water Gauge herewith illustrated, was designed and patented by The Lunkenheimer Company, of Cincinnati, Ohio, who are its sole manufacturers. There are quite a large number already in use, all of which are giving perfect satisfaction.

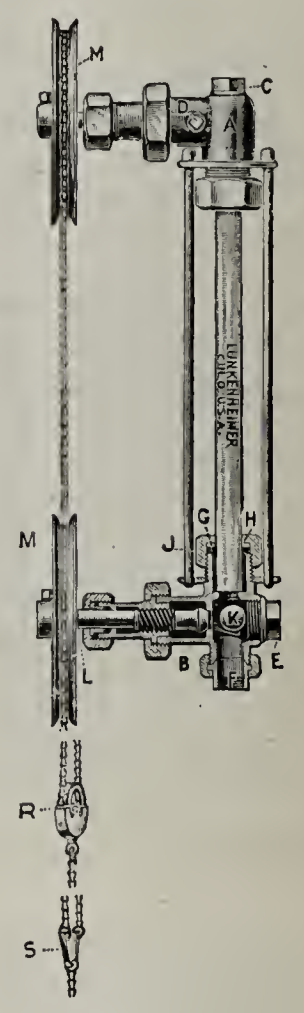
They are made in two patterns, termed "Medium" and "Extra Heavy," and are intended for 200 and 300 pounds working pressures respectively. They are made either right or left hand, as desired, to facilitate the operation of the gauge.



Should the gauge glass break, the ball check valves K will automatically seat themselves, owing to the rush of steam and water on one side thereof, and the lack of pressure on the other. This automatic closing feature is a valuable one, as it prevents the escape of steam and water, and permits the safe closing of the hand operated valves for the purpose of renewing the glass.

To renew the glass, it is only necessary to loosen the stuffing boxes G, take off the cap C, remove the broken glass and substitute a new one, after which the stuffing-boxes are tightened and the cap C replaced. The change can be performed with perfect safety, for, owing to the quick-closing valves, which should be closed upon the discovery of the broken glass, there is no danger to be anticipated from escaping steam and water.

Particular care has been exercised in the design of the gauge to facilitate cleaning, and access can be readily had to any part. The plugs C D R and N are provided for this purpose. By removing the plug D and opening the regrinding valves to their greatest extent, a rod can be inserted entirely through the body and tail pieces, and any sediment that might have collected in or around the entrance of the tail pieces can



thereby be easily removed. By unscrewing plugs E and N, the check balls will of their own accord fall from the body, as they rest on inclined surfaces.

It has been the practice heretofore to attach both pulleys together by means of a chain or cord, which was pinned to the pulleys, so that the proper closing of one depended entirely on the other. While in some cases this method was satisfactory, it has been found that unless great care was exercised in pinning the chain to the pulleys, or after the valves had been reground several times, one of the valves would not seat properly. To overcome this difficulty, the arrangement illustrated herewith was designed, by which it will be readily seen that both valves can be made to positively seat independently of each other. This arrangement consists of a block pulley operating over a chain, which is pinned to both the upper and lower pulleys, this method being employed for closing the valves. Should one of the valves become closed before the other, a continued pull on the block chain will close the other. To the left of the pulleys, the chain is merely attached to

a triangular plate, as the opening of the valves need not be regulated to as fine a degree as the closing thereof.

The valves are constructed on the same principle as the Lunkenheimer well known regrinding valves; therefore they can easily be reground when worn.

The valve seat opening is very large, being nearly twice the diameter of any other quick-closing water gauge on the market, and consequently a free and unobstructed passage for the water and steam is insured.

The gauge can not show a false level, as the ball checks are so constructed that unless the glass breaks, they will, owing to their weight and position, fall away from their seats.

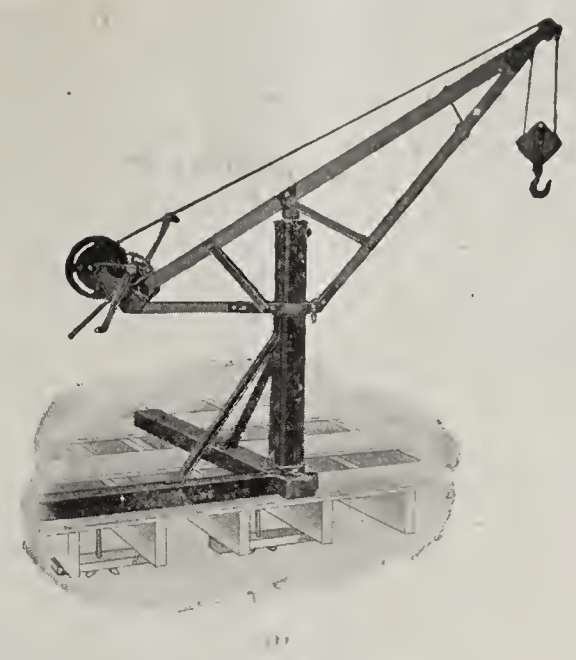
The Lunkenheimer Company has issued an attractive booklet thoroughly describing and illustrating this gauge, which they are distributing free to anyone desiring a copy. The gauge has been given the trade name of "Monitor."

SPECIAL LINE OF DERRICKS

A line of builders' derricks that deserves the special attention of Cement & Engineering News readers is being offered by Sasgen Brothers.

The Sasgen Reinforced Circle swing builder's derrick shown below is without question one of the most practical hand power derricks made for building and structural work, loading and unloading cars and wagons from platforms, well digging and various other purposes. It can hoist 300 feet. The fittings on this machine are all crucible steel and malleable, including the geared winch, which makes the derrick safe and durable. They can make this derrick if so desired to be used by hand or power for an additional $3.00. It is 8 feet in height, weighs 350 pounds, and has a circle swing of 10 feet. It is equipped with 150 feet of cable, swivel block, fasteners, band brake for load, boom brake to keep boom from swinging when hoisting. It has a hoisting capacity of 2,500 pounds.

The Sasgen pole derrick is extensively used by builders for setting posts, girders, joists, stone coping, etc. This derrick weighs about 200 pounds, is equipped with winch, 100 feet of cable and block. It



SASGEN DERRICK

is made of 5½x5½ selected Norway, provided with extension sheave frame. The fittings are of best malleable castings.

The improved setter derrick is another product of this company. The top frame of this derrick is made of the best malleable iron, is equipped with two sheaves, which eliminates the block on top. This frame is supported by ⅝-inch truss rod and has lugs for guy lines in front and back, also clamps for fastening extension pole. The bottom and side pieces are

"Has given us better satisfaction than any other belt we ever used"

This is what a large mining and smelting concern recently wrote us about a Goodrich Elevator Belt. In the same letter they said: "Our principal use for this belt is to elevate granulated copper slag. One of these elevators elevates four or five hundred tons per day of 24 hours. You can readily see that the demand made upon these belts is very severe."

Goodrich Elevator Belts

wear longer—because made better

They are of special quality. They are built on a duck of close hard weave and heavy weight which gives increased tensile strength and a firmer grip to bucket bolts. The friction rubber, which binds together the plies, is of very high quality. The cover is tough and resilient, resisting to a maximum any abrasion and cutting by small particles.

Write for further particulars.

The B. F. Goodrich Company

Factories: AKRON, OHIO — Branches in All Principal Cities.

Makers of Goodrich Tires and Everything That's Best in Rubber

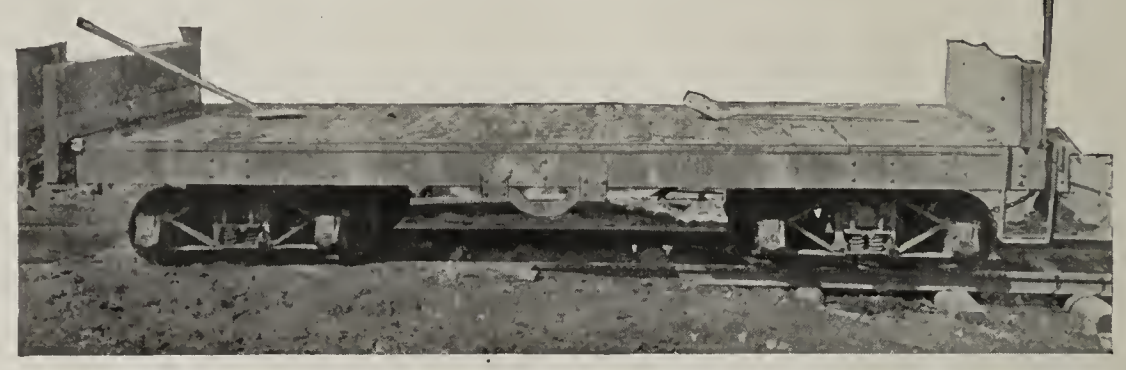
There is nothing in Goodrich Advertising that isn't in Goodrich Goods

connected with two malleable castings and fastened by means of bolts so the derrick can be easily taken apart if necessary for shipment or removal. Sasgen Brothers also manufacture derricks made entirely of steel. Write them for circular, prices, etc. Sasgen Brothers, care Cement & Engineering News, Schiller Building, Chicago.

QUARRY CARS FOR HANDLING STONE OR CLAY

The economical handling of stone is the subject of greatest importance to the quarry owner and after receiving numerous requests for information on this subject we have compiled this article covering, we believe, the important features very thoroughly.

Cars which are to be used in quarry service for carrying the stone from the quarry to the crusher should meet the following requirements:



First: Height from ground to top of bed should be as low as possible, particularly if cars are to be loaded by hand.

Second: Cars should be able to be dumped instantaneously and automatically when they arrive at crusher, both to save time in unloading and to save the cost of unloading by hand.

A large number of different designs have been made up for such service, but it is not possible to make a car of which the body will dump without also making it so high that it cannot be loaded by hand, if the capacity of the car is to be large enough to make it economical. This, of course, does not apply to cars which are loaded by a steam shovel as the height of these cars can be several times as high as the car which is to be loaded by hand, but a low car is also an advantage for steam shovel service, as it makes it possible for the steam shovel to load the cars for a longer time without shifting the tracks. There have been several designs of cars made which had a separate body hinged on one side to the underframe in connection with which an air or electric hoist located at the crusher was used. A hook from this hoist engaged a side of the car opposite crusher, lifting the body up so that the load would slide into the crusher. A car constructed in this manner, however, is very expensive as it requires practically two underframes and if a large number of cars are used the cost of the equipment is increased excessively.

When the Warren Silica Company were installing their new quarry equipment this point was taken up and in connection with the Engineers of The Orenstein-Arthur Koppel Company, of Pittsburg, Pa., a system was devised which would lessen the cost of the equipment and make unloading cheaper than it would be with any of the other types of equipment mentioned. The accompanying cuts show the equipment which was installed and it will be noted that the type of car installed consists of a very low type double truck flat car, which had a platform 20 feet long by 6 feet 6 inches wide by 2 feet 9 inches high to top of floor, thus making it possible for men to load the car without any extra exertion. At the crusher is installed a platform hinged at one side and supported by the other on two air cylinders. When the car arrives at the crusher it runs on this platform a catch engages the side of the car automatically and by admitting air into air cylinders the tipple with the car, is lifted up so that the car floor assumes a slope of 45 degrees, the load then slides off the car into the crusher and upon releasing the air from the cylinders the tipple assumes an upright position and the train moves on, bringing another loaded car on the platform.

This plan of operation has proven very satisfactory and economical. The time and labor taken in dumping the car being less than with any of the types of equipment mentioned.

It's 10 Shovelers in One

"Fairly Eats Work."

The Link-Belt Portable Wagon Loader on Contract Work. Upper Chute for Loading Wagons or Railroad Cars.

The Link-Belt Portable Wagon Loader

Loads Sand, Stone, Gravel, Coal, etc., more quickly and economically than any other low-first-cost method. Handles 40 yards of stone an hour, or a ton of coal (or similar material) a minute. Saves 5 to 10 cents a ton in loading.

The scarcity of efficient common labor makes the wagon loader a most profitable investment for contractors and dealers. It solves the labor problem by giving increased capacity with fewer men. It is always ready for work—never "loafs" nor "goes on strike."

If you load loose material in quantities, you owe it to yourself to investigate this Link-Belt Wagon Loader.

Price, Booklets, Records of Performance, Testimonials, Facts and Figures upon Request.

SIMPLY RETURN THE COUPON.

LINK-BELT COMPANY

Nicetown, Philadelphia, Penna.

Send us price, booklet, and full particulars regarding the Link-Belt Portable Wagon Loader.

We load about _____ { tons / yards of _____ a day

from _____ to _____

_____ 1913

(Name) _____

(Address) _____

(Town) _____

(State) _____

THE CONSTRUCTION ENGINEER IS THE ONE MAN WHO

actually rubs shoulders with the Building Material Problem. Talk it over with him. He will be eloquent on the necessity of using a waterproofing compound which

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5--And is sure to be **Hydrostatic Pressure** Proof

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SAND-LIME BRICK

Regarding the sand lime brick industry in so far as the Buffalo market and vicinity is concerned, beg to say that the same is very good. We have had no trouble in disposing of our output and have orders booked ahead which will keep our plant running full force until January 1st, 1914 at least, writes Andrew F. Kempf, general manager of the Buffalo Sandstone Brick Co., Buffalo, N. Y.

At present we are delivering 300,000 brick for a plant to be erected by the Beaver Board Company and by the way wish to say that we have furnished them all the brick for the various factories they have erected before and they used up to the present time about a million and a half of our brick.

We will have a large furniture factory and a church to furnish sand lime brick for in the course of a few months where the owners insist on having sand lime brick and nothing else.

The City of Lackawanna has just completed their new City building and all common brick in this building were sand lime.

The outlook here in Buffalo is exceptionally good and find that once an owner has used sand lime brick he invariably returns for the second order when again building.

At present we are delivering brick for 10 to 15 buildings in Buffalo ranging from 50,000 to 200,000 brick for the different jobs and our experience has been, that better advertising is done by distributing the brick on more jobs, than instead of one or two large buildings.

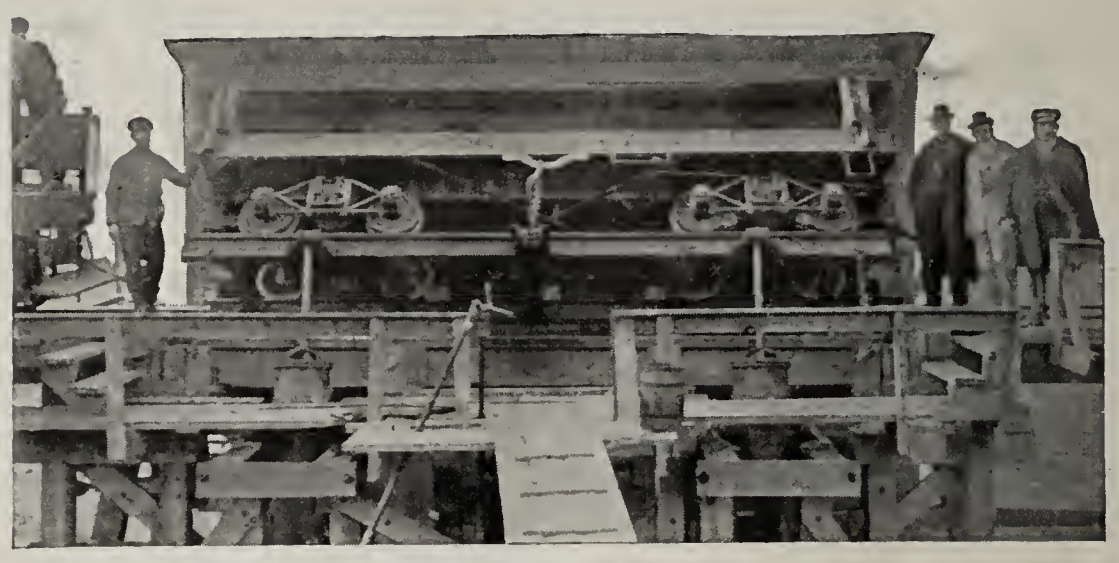
NEWS ITEMS

An interesting development has arisen in connection with the use of bulk cement. At Summer, Ill., the concrete products plant operated by Blood Bros., is located at some distance from the railroad siding. They have found it to be a decided economy to empty sacked cement into bins and to ship back the bundled sacks without delay. This has served both to save wear and tear on the sacks and to decrease the investment ordinarily tied up in sacks. Often credit has been given for sacks prior to the actual billing of the cement. They state that there has been an additional advantage due to the bulk cement caking to a less degree than the sacked cement. During the Eastern Flood they had some sacked cement piled on a floor at the same level as their bin of bulk cement. The former absorbed considerable moisture and became lumpy while the bulk cement at the same level was unharmed and not a single lump formed. The owners do not explain this but merely state it as a fact.

So far the only company furnishing cement in bulk is the Universal Portland Cement Company, who have energetically pushed its use for railway, dock and concrete products plant work.

INLAND CEMENT PLANT

The Inland Portland Cement Company, Metaline Falls, Wash. we are informed use a large steam shovel manufactured by the Marion Steam Shovel Company, Marion, Ohio, for loading rock in their quarry. From the No. 5 Gates crusher the stone is conveyed to the storage bins, and from the storage delivered to the mill by Leschen automatic tramways. The drilling equipment in the quarry was furnished by the Hardsocg Drill Company, Ottumwa, Iowa. The Link Belt Company of Chicago and Philadelphia furnished all the elevating and conveying machinery in their new cement mill.



ORENSTEIN-ARTHUR KOPPEL DUMP CARS AT THE PLANT OF THE WARREN SILICA CO.

WESTINGHOUSE ELECTRIC MFG. CO.

Among recent orders reported by the Westinghouse Electric & Manufacturing Company are the following:

The entire equipment of the brick machinery with electric motors in the plant of the West Virginia Fire Clay Company, at Empire, Ohio.

The Keystone Brick Company, Watsontown, Pa. to be completely equipped with motors.

The Kosmos Portland Cement Company, Louisville, Ky. is installing additional tube mills and Fuller mills which will be driven by electric motors.

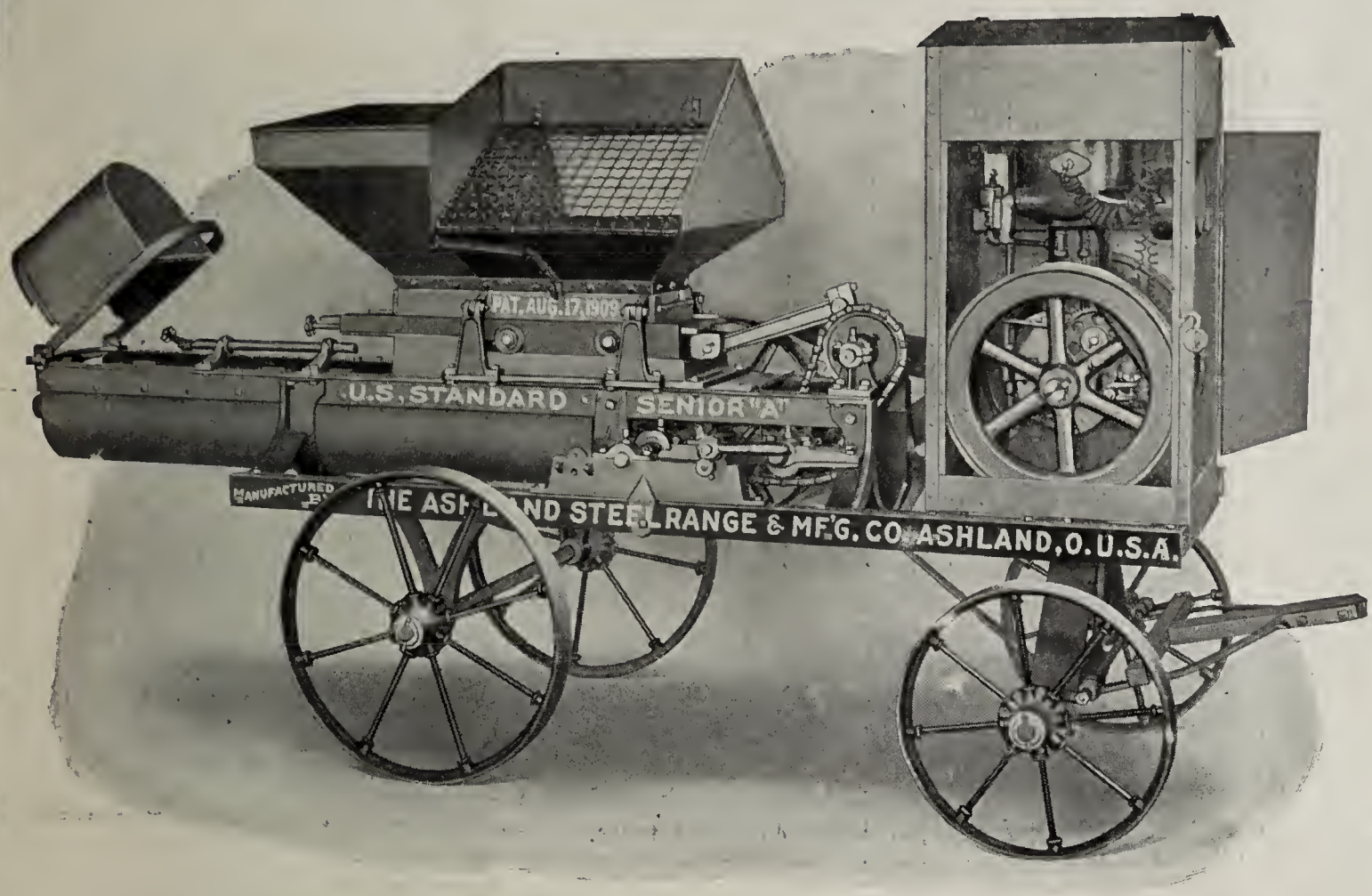
The Miller Rubber Company, Akron, Ohio, is installing an additional calender which will be driven by a Westinghouse motor.

Three calender motors for the Goodyear Tire & Rubber Company, Akron, Ohio.

Transformers for the electrical equipment of the Fiske Rubber Company, Chelsea, Mass.

The Motor equipment for the Ferro Brick Company, Watsontown, Pa.

U. S. STANDARD CONCRETE MIXER.



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Mixes Dry Before Water Is Supplied Giving Thorough mixed, Uniform Product.

Capacity 7½ Yards Per Hour. Other Sizes in Stock at all Times.

Ask for Bulletin 21 and Mention Cement and Engineering News When Writing.

R. R. REED, General Sales Agent, ASHLAND, OHIO.

Step Forms For 1 or 100 Steps of any size

Do Away With Carpentry— It's Expensive

You can't afford to waste time on wooden forms if you expect to do your share of concrete step construction this season. No two sets of steps are alike in dimensions, and to build new forms for each job, it would require a big share of your time and profits. Before the season sets in, better look into the merits of the

Indiana Adjustable Step Molds

Adjustable to all sizes, enabling you to use the same forms on hundreds of different sized jobs. They are complete in themselves, not simply form holders, but a complete set of molds for molding concrete steps.

Circulars and prices on request.

Indiana Concrete Mold Company

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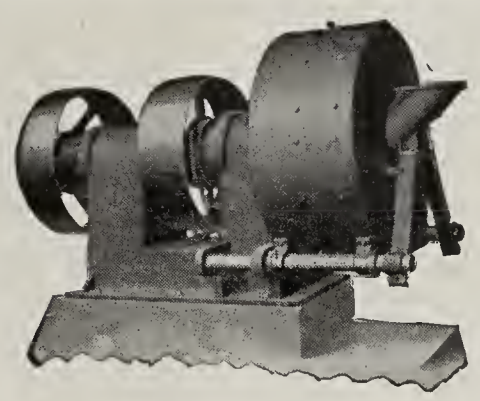

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Disc Crushers follow first breakers.

Reduce the output to small sizes.

Capacity 48″ size crushing 7″ stone to 1″, 50 to 60 tons per hour.

Adjustable. Made in five sizes. Careful attention to your inquiry.

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Among The Cement Mills

IDAHO PORTLAND CEMENT WORKS

The Idaho Portland Cement Works, Ltd., has under construction a modern cement manufacturing plant on the west bank of the Snake river in the town of Asotin, Wash., the site for which comprises about ten acres of land. The Inland Engineering & Construction Company of Asotin, Wash., designed the plant and has the contract to erect the buildings and install the equipment. The president of this engineering company is F. W. Freeborn of Kansas City, Mo., head of the F. W. Freeborn Engineering Company of that city.

Construction work is being actively prosecuted on the enterprise. The office building, the machine shops, the storage warehouse with a capacity of 75,000 barrels, and the coal mill, all of reinforced concrete and steel, are now completed and the foundation work for the balance of the buildings is erected and is now awaiting the fabricated steel for their completion.

The conveyor trestle from the wharf to the different buildings of the mill is also completed and large shipments of machinery are expected shortly.

Approximately $150,000 has been expended at Asotin to date, and when the company is ready to begin manufacturing not less than $700,000 will have been expended.

The material to be used in making white and gray cement is located at Lime Point, situated on Snake river, eighteen miles up-stream from Asotin. These large deposits are on the Idaho side, opposite the mouth of the Grand Ronde river. The materials have been tested and sampled by the most prominent and competent chemists in the country and have been found to be of exceptional purity and strength.

A thoroughly-up-to-date and modern quarry equipment will be installed at Lime Point, including two enormous gyratory crushers, loading docks, conveyors, trestles, and six buildings for the workmen, office, commissary and general stores. The plan is to float the raw materials down stream to the plant, where there are to be docks and bins with electric derricks and conveyors for delivering the rock and fuel to the mills.

LABORATORY EQUIPMENT

The Henry Heil Chemical Company, St. Louis, Mo., were awarded the contract by the Edmonton Portland Cement Company, Limited, Edmonton, Alberta, Canada, for furnishing the equipment in their new laboratory.

MONARCH PLANT SOLD

The Monarch Portland Cement Company, Humboldt, Kansas, capitalized at $4,000,000, was purchased by E. A. Nossaman of Cheney for $175,000 at the receiver's sale here today. Mr. Nossaman purchased for preferred stockholders. He stated that the company would be immediately reincorporated as the Monarch Cement Company and would resume work at the Humboldt plant within the next two weeks.

The company has been in the hands of receivers.

As there are $2,000,000 of preferred stock outstanding and the amount paid for the plant is only $175,000, there is little likelihood of the common stockholders receiving very much from their investment.

ALTOONA CEMENT MILL

W. S. Trueblood, formerly Chief Chemist of the Altoona Portland Cement Company, and recently Chief Chemist of the Syracuse Plant of the Sandusky Portland Cement Company, has been appointed Assistant Superintendent of the Altoona Portland Cement Company, and will succeed Mr. C. W. Lyon as Superintendent on Sept. 1st, 1913.

The plant of the Altoona Portlant Cement Company, Altoona, Kansas, has been remodelled along the lines of a general layout submitted to the Company by Mr. Lyon in 1911.

An innovation in this section of the country is the installation for the mix to be made at the quarry immediately following a No. 8 Crusher which handles the rock and a No. 3 Williams mill for pulverizing the shale. These materials are carried by a belt conveyor to large storage bins passing through a mixing scale delivered to a belt conveyor 600 feet long which in turn delivers the material to two 6x60 foot dryers.

The dryers discharge the mix into a Williams mill from which point it is conveyed by a belt conveyor and delivered into five storage bins having a capacity of 2500 tons.

A new cement stack will be built at the plant of the Michigan Portland Cement Company, at Chelsea, Mich., replacing the small stub stack now in use in connection with mechanical draft in the power plant. The new stack will be about 110 feet high and six feet in diameter. The large cement stack already in use is connected only with the fires in the rotary kilns. It is 150 feet high.

The Iowa Portland Cement Company, Des Moines, Iowa, today submitted plans to Smoke Inspector Harry McNutt, calling for the establishment of a smoke consuming system at a cost of $150,000. The required equipment is probably the largest ever installed in Des Moines.

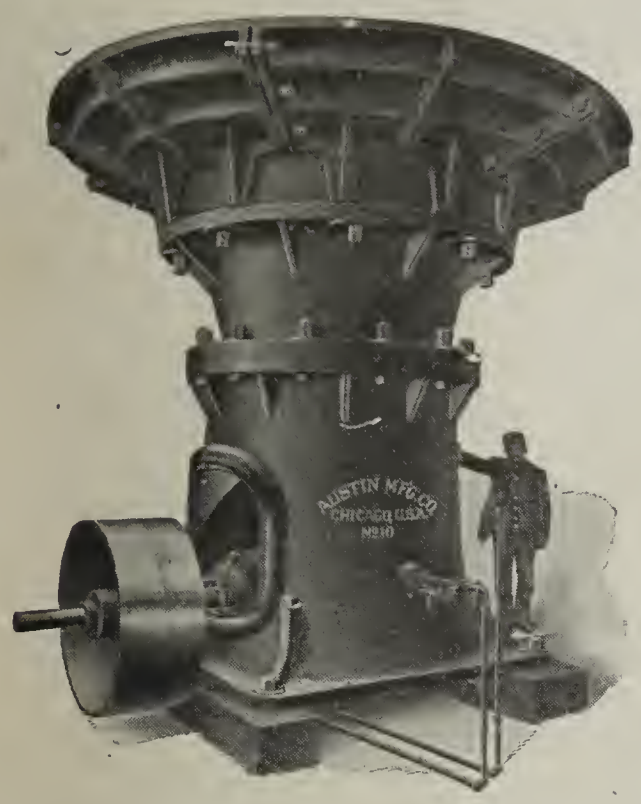
The agreement of the company to install the smoke consumer came following the filing of information in police court, charging the maintenance of a nuisance. People residing near the plant are complaining bitterly. Inspector McNutt declares that the smoke consumers will be installed as soon as possible. Several days will be required to check over the plans to see whether or not they conform with the city regulations.

EDMONTON CEMENT COMPANY

The Edmonton Portland Cement Company held its annual meeting of shareholders at the head office, Edmonton, Alberta. The directors announced ample funds on hand for the completion of the 1,500 barrel plant at Marlboro, Alberta. T. H. Klossoski, chief engineer, announces the plant in operation.

Lewis G. Eaton, Ithaca, New York has been appointed chemist for the company. Mr. Eaton was formerly with the Iola Portland Cement Company, Monarch Portland Cement Company, German-American Portland Cement Company and York Portland Cement Company.

Austin Gyratory Crushers



The World's leading Ore and Rock Crusher. Its many superior qualities and mechanical advantages have won the highest reputation amongst Mining Engineers and Quarrymen.

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LOADING bore holes with a Du Pont Explosive adapted to blasting conditions in the quarry, affects quarrying costs.

The following brands are being widely and effectively used in a large number of quarries and are solving the problem of how to increase production and do so at lowest cost for explosives.

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DU PONT GELATIN
DU PONT BLASTING POWDER

Amongst these is one or more competent to make improvement in the work of blasting, better the working conditions and make a favorable record when compared with the performance of explosives formerly used.

We have a corps of experts able and willing to assist you in the selection and application of the proper brand of Du Pont Explosive. Send us the data and benefit from our century of experience in explosive manufacture.

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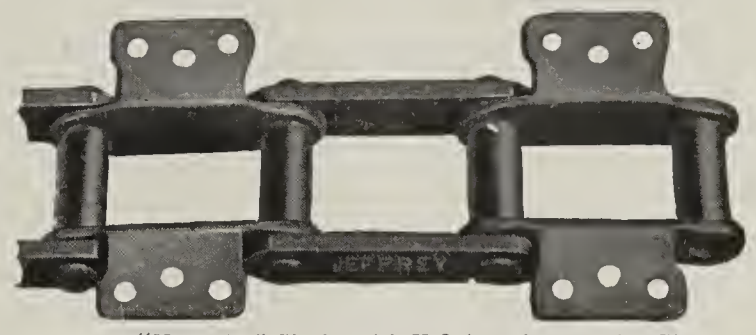

Jeffrey "Hercules" Chain with K-2 Attachments for Single Strand on Back of Buckets

The Superior Chain for Handling Coarse and Gritty Materials

Jeffrey "Hercules" Malleable and Steel Combination Detachable Chain

THE only riveted chain of this type on the market. The bearing surface is protected by the rivet heads, insuring longer wear and a delivery of from 2000 to 5000 pounds more per chain than cotter pinned chains of inferior makes.

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The Jeffrey Mfg. Co. Columbus, Ohio

New York	Pittsburg	Chicago	St Louis
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RESUSCITATION

To the courtesy of the Westinghouse Electric & Mfg. Co. of Pittsburgh, Pa., we are indebted for the receipt of a very valuable little booklet on resuscitation from electric shock, drowning or asphyxiation prepared by their medical director Dr. C. A. Lanffer.

This book should be in the possession of all superintendents and foremen of factories where electrical apparatus are installed or where workmen are exposed to chemicals, as by its aid and by attentive study of the method described most people can be readily restored to life who are overcome by chemicals, have been drowned or have been injured by electric shocks.

In the past, workmen at industrial plants were mostly allowed to die if, by one of the above-named accidents, their heart-action was arrested. In fact, the men were only apparently dead and could have been restored to life by a simple process of artificial respiration, if their comrades would have been familiar with the method described in this booklet and could have given them immediate assistance before medical aid was at hand. By the time a physician arrived it was frequently too late to restore the patient to life. Therefore, it should be the duty of all people superintending modern industrial plants to familiarize themselves with this method of giving aid to the described kind of sufferers, especially as it requires no apparatus whatever and calls for merely an hour's time to carefully study the operations necessary to restore the patient's lungs and heart action to their proper function.

CARE ON PART OF CONTRACTORS IN DOING CONCRETE WORK

In speaking of the concrete bridges and their construction in the city of Pittsburgh, N. S. Sprague, superintendent of the Bureau of Construction of that city, made the following pertinent remarks before the ninth annual convention of the National Association of Cement Users:

"However carefully and accurately designed, a concrete bridge may be, the work of the designer may be set at naught by delegating the construction to incompetent, inexperienced and unskillful contractors. A large bridge is an imposing and monumental structure, generally used and seen daily by thousands of people, which emphasizes the importance and makes necessary for the engineer to require the same degree of excellence of workmanship and skillful management as the architect demands in the execution of his plans for some magnificent building. The problem of the engineer in this respect is much more difficult of attainment than for the architect, since on concrete bridge construction most of the work is performed by unskilled labor and with the use of more difficult materials. A large concrete bridge is composed of a number of large monolithic sections, which must of necessity be built in several parts at different times and under varying conditions, all of which demand the utmost attention and watchfulness to the adequate bracing of the forms and their true and correct alignment. The bulging of a form or the unnoticed escape of grout from the concrete are defects which may not impair the strength of ordinary construction and which are easily remedied in most forms of concrete work, but in bridge work these accidents are likely to result in ruining the appearance of the whole bridge.

CONCRETE ROADS AND PAVEMENTS.

Concrete Roads and Pavements is the subject of a new book just off the press. This book written by E. S. Hanson, is representative of the very best practice known in construction of concrete roads and pavements and we are confident that it will have a welcome reception on the desk of a great many engineers and contractors. Price $1.00. Address Cement & Engineering News, including money order.

"REINFORCED CONCRETE WALL FOOTINGS AND COLUMN FOOTINGS," by Arthur N. Talbot, has just been issued as Bulletin No. 67 of the Engineering Experiment Station of the University of Illinois.

The load on a building or other structure is transmitted to the earth through the footings under the walls and columns. Uncertainties exist in regard to the strength of footings and to the magnitude and distribution of the stresses. This bulletin gives the results of an important and extensive series of tests, in which footings were loaded in such a way as to approximate the conditions to be expected in structures. A discussion is given of the various factors which must be considered in designing footings and of the formulas which may be used. The tests indicate that certain elements of design have not always been given the proper consideration. This is the first set of tests of the kind known to have been made. Copies of Bulletin No. 67 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Van Duzen Concrete Mixer

Price $165.00

This is a **ONE-SIXTH** yard mixer. Two wheel-barrow loads per mix. Daily capacity **50 YARDS.** Mounted complete with **2½ H. P. Engine.**

Manufactured under basic U. S. letters patent No. 782,700. BE CAUTIOUS, you are protected when you buy a Van Duzen.

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Van Duzen, Roys & Co.,

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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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IMPORTANT NOTICE.

When your subscription expires, renew at once, using the blank which will be sent you. If it expires with this issue, your renewal must reach us before the 5th of the next month, to avoid missing the next number.

Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

Advertising Rates Sent on Application

JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, OCTOBER, 1913

REVIVAL OF THE CEMENT BUSINESS

Now that the tariff revision is nearing its end and all branches of business have had time to adjust themselves to the changed conditions accompanying the new administration, business men are more hopeful of the future and are beginning to take up again enterprises which were in the early stages of development at the time when the change in the administration occurred and which had to be dropped temporarily for lack of confidence in business affairs generally or out of fear of what the future might bring.

The tariff has been revised by the democratic administration and numerous other equally important decisions are going to follow in the near future and yet this country is able to go about its business cheerfully to the great surprise of many republicans who predicted panics and a prolonged stagnation of all business under the new government. All these foreboders of hard times accomplished was a temporary let-up in some branches of business and a general house cleaning in all industries which compelled us to take an inventory of past happenings and to prepare for the future perhaps with more wisdom than ever done before.

The time that thus elapsed in anticipation of new events and in gradually becoming accustomed to the new conditions has been long enough to empty the warehouses that were well stocked and to create a new demand for all articles. In the cement industry especially the latter is keenly felt at present. Work that has been left undone for years has to be contracted for now. Moreover, an entirely new field of usefulness for cement has been added to its former application, namely, concrete road construction which promises to put an end to the building of macadam roads and which in the course of the next ten years will probably consume as much cement as all other uses of cement combined. We, therefore, would not be surprised to see the already large production of cement of the United States doubled within ten years. This would be even a conservative estimate if the enormous amounts of cement are considered that will be used in the future in road construction, to judge from the propaganda made for the application of cement for this purpose throughout this country and from the fact that thousands of miles of concrete roads are contemplated in every state of the Union.

That, under these conditions, established plants double their capacity and new cement plants continue to grow up all over the country can surprise only people not conversant with the vast amount of construction work ahead of us. Of course, there are localities possessing an abundance of cement mills, as for instance the East and the state of Kansas, while others, for instance, the states of Oregon and Montana, for economic reasons, seem to be greatly in need of home-made cement.

CONCRETE SILOS

Polk-Genung-Polk Company, Fort Branch, Ind., manufacturers of the Polk system of reinforced monolithic concrete silos, has in their possession a mute but remarkable testimonial of the advantages of concrete silos over those constructed of other materials, in the form of an actual photograph taken on the farm of Garrett P. Jones, of Frankfort, Ky., after a cyclone, July 26, 1913, had leveled and scattered over a large area all the structures which stood in its path—all except Mr. Jones' concrete silo, which was directly exposed to the fury of the mighty whirlwind and which was unharmed. Mr. Jones, needless to say, is now more than ever a staunch believer in the superiority of concrete construction and in the Polk-Genung-Polk system of silos in particular.

ROCK AND CONCRETE WORK

The Medford Concrete Construction Company, managed by C. A. Semon, is operating a basalt quarry and a crushing and screening plant on the P. & E. railroad, near Medford, Oregon. The principal work there is supplying crushed basaltic rock of any required grade for road and street macadam and paving.

This company also operates at Medford a plant for machine made concrete pipe for sewers and other purposes, using the Thomas pipe machine for this purpose.

STATEMENT OF OWNERSHIP, ETC., FOR POSTAL AUTHORITIES.

Statement of the ownership, management, etc., of Cement & Engineering News, published monthly at Chicago, Ill., required by the Act of August 24th, 1912.

Note—This statement is to be made in duplicate, both copies to be delivered by the publisher to the postmaster, who will send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the Postoffice.

Publisher, Editor, and Managing Editor, William Seafert, Chicago, Ill.

Business Manager, J. F. Waldron, Chicago, Ill.

CEMENT & ENGINEERING NEWS is not incorporated; it is owned solely by William Seafert; residence, 435 S. Marshfield Ave., Chicago, Ill.

There are no bond holders, mortgagees, or other security holders, outstanding against Cement & Engineering News.

Sworn to and subscribed before me this twenty-sixth day of September, 1913.

(Seal) ROBERT A. CLARA, Notary Public.

(My commission expires Aug. 17th, 1916.)

OLD MISSION COMPANY'S MODERN PLANT

E. U. Leh, who is one of the old guard of the Portland cement industry and a veteran of the Lehigh Valley of the early days, is now living on the Pacific Coast, but is still in the Portland cement business in the capacity of general manager of the Old Mission Portland Cement Company at San Juan, Cal., which will go into bearing early next spring.

Mr. Leh recently gave the following description of the construction and operation of the plant which is rapidly reaching completion at the present time:

"We are building a high-grade Portland cement mill, designed to produce 4,000 barrels of cement a day. The raw materials will consist of a very fine specimen of lime rock and clay, while fuel oil will be used for burning the clinker. Seven kilns eight feet in diameter and 125 feet long have been installed, together with two clay driers of Bonnot make; 14 Bonnot tube mills five and one-half by 22; two Allis-Chalmers Anaconda break chain rolls; one No. 8 Gates crusher; one Jumbo Williams pulverizer, and two 66-inch Griffin furnace grinding mills make up the reducing end of the mill.

"The equipment for handling raw materials consists of a 65-ton Marion steam shovel, manufactured by Marion Steam Shovel Company, Marion, Ohio; a 20-ton American saddle tank locomotive; 14 20-ton air dumping steel cars, with railroad tracks running from San Juan to Chittenden, a distance of nine miles, connecting the plant with the Southern Pacific railroad. This little railroad is known as the California Central and will eventually be extended to Tidewater, giving the plant shipping facilities both rail and water.

"The plant itself is located half a mile beyond the city limits of San Juan. The plant is also being equipped to furnish crushed limestone for the sugar industry, crushed rock and sand for building purposes, as well as lime, for we have already a plant consisting of three modern lime kilns producing 300 barrels per day. As an addition to the lime plant, a hydrating mill will be added in the very near future.

"The cement mill will be in readiness for full operation by the first of March, 1914, beginning with the delivery of a contract to the state of California of 1,500,000 barrels of cement, which order has been booked for some time.

"The company owns its own property, the rock and clay for the cement material, as well as the lime and limestone, besides the oil wells which will supply both the cement and lime plants with fuel. The prospects of exporting cement from this plant are considered to be very fine, as it is located only 15 miles from Tidewater, in the central part of California, and naturally has a fine market in the valley of Santa Clara.

"The present contract with the state for its supply of cement provides for a number of public buildings and includes highways and harbor commission work in conjunction with the same. In this particular line the Old Mission Portland Cement Company has a contract for all the cement that the state will use for a period of years. The state features of the Panama Canal Exhibition will be a considerable consumer of the cement from this plant.

"The entire manufacturing capacity of cement in California at the present time is between 8,000,000 and 9,000,000 barrels per annum, all of which is being successfully marketed and still considerable quantities of European cement are imported."

Several years ago Mr. Leh was associated with the Cowell Portland Cement Company, of California, starting their plant to successful operation, and for the past few weeks he has been making an extended tour of his old camping grounds throughout the Lehigh Valley and New York state. He says that he has found quite a considerable improvement in the manufacture of cement which has been accomplished in the last five years over the methods and practices that were used before he went to the Pacific Coast. Incidentally he reports cement conditions throughout the length and breadth of his eastern visit as being very good, with prices well maintained, and says that this condition is better now than it has been for years.

Returning to the discussion of the new plant at San Juan, Mr. Leh referred to his memoranda, stating that "the crusher building measures 50x140 feet, raw grinding building 130x132 feet, kiln building 123x152 feet, drying building 90x111 feet, cement warehouse 110x200 feet, machine shop 40x72 feet, blacksmith shop 24x40 feet, storeroom 40x75 feet, clinker storage 80x350 feet, laboratory 36x56 feet and office building 28x48 feet.

"The first shipments of the output of the Old Mission Portland Cement Company's plant has already started by the purchase of crushed rock by paper manufacturers in the vicinity of the plant."

The officers of the company are: J. C. Kemp van Ee, president; L. A. Hilborn, vice president; P. F. Unger, secretary, treasurer and purchasing agent, all of San Francisco, Cal., and E. U. Leh, general manager, San Juan, Cal. The capital stock is $3,500,000.

FINENESS DETERMINATION IN CEMENT

Could not something be done by your paper to bring about a closer concordance in fineness determinations in cement, particularly in the case of the 200-mesh sieve? writes Bernard Enright, director, Eastern Testing Laboratories, Allentown, Pa.

The practice of today is to have sieves approved by the Bureau of Standards, whose examination is thorough, as far as it goes, including the count of the mesh and the measure of the diameter of the wires. This is not entirely satisfactory, however, for the reason that it is possible to obtain a widely varying fineness on the same sample with two sieves, both approved by the Bureau of Standards, the discrepancy sometimes being as great as results of 85 per cent through one sieve and 80 per cent through another, on the same sample of cement.

It appears to me that the solution would be, to not only check the mesh and diameter of the wire, but to also check the sieve by making a determination with it on a large standard sample of cement, of course, most carefully prepared, and of a carefully determined fineness, and approving only sieves which agree within, at least, a percent, in an actual determination on this standard sample, or furnishing a plus or minus correction, (based on determinations on the standard cement sample), to be used with the sieve.

There is no question that testers and engineers are much more interested in the uniformity of the results obtained with the sieves than they are with the mere details of the count of the mesh or determinations of the diameter of the wire. Those details would necessarily have to be correct to give uniformity of results, but experience has shown that it by no means follows that sieves showing, on examination, a mesh count and a wire diameter within specifications, agree in results in actual determinations.

We are constantly having trouble throughout the United States through such differences, each laboratory invariably claiming government approval of their sieves, and that, therefore, their sieves must be correct, and we have many times taken such sieves, and with the same tester, on the same cement, found extremely wide variations, as noted.

We believe that you will do the industry a great deal of good by having this brought to the attention of the engineers, as well as to the screen manufacturers and the Bureau of Standards.

PRESSURE TEST IN WET CONCRETE

In order to determine if possible, proper figures of strength and factors of safety to be used in designing forms, the Aberthaw Construction Co., Boston, Mass., has recently made some tests of the pressure of wet concrete. The tests were made on small area columns

FIG. 1.

where it was easy to obtain a high pressure head in a short time. They are therefore mainly applicable to that condition of laying concrete. Besides this, however, the tests are of considerable value in connection with general form design, particularly in showing that the somewhat heavy forms used by the Aberthaw Company are more than justified.

In each column tested were placed six ordinary hot water bags at vertical intervals of three feet. These bags were filled with water and carried inside a test tube containing mercury and having a glass tube run through the rubber stopper in the neck of the hot water bottle to a point well below the level of the mercury in the test tube. This glass tube was in each case bent out to go outside the column of concrete and then bent up again, as shown in Fig. 1. The mercury levels indicated on the glass tubes were read on each tube after the column was filled with concrete.

As the concrete is poured it presses directly against the surface of the hot water bag. The reaction is transmitted to the water in the bag and is equal to the concrete pressure. This water exerts the same pressure on the surface of the mercury in the test tube, forcing mercury to rise in the small-bore glass column. The pressure in inches of mercury, which is readily translated into pounds per square inch, is given by the difference in level between the mercury in the test tube and that in the column. As the pressure is figured from a fluid head the area of the bag exposed has no influence.

As the mercury in the test tube is not visible after the concrete is poured it was necessary to calibrate in order to determine the pressure necessary to cause a rise of one foot in the small tube. The test tube was filled with mercury to within one inch of the top and put in the bag. The top of the tube was then found by feeling and the level of mercury determined as one inch lower. This level drops as the level in the column goes up, the amount being determined by forcing the mercury up in the column, a distance of 12 inches, and measuring the depression in the level in the test tube. From this amount a correction was made to fit each case.

In Fig. 2 will be seen the arrangement of the bags on the test face of the form; while the reinforcing of the columns is shown to the right of the bags. Each column was 20 inches square and about 20 feet high. This was in no sense a laboratory test but was carried out with sufficient care and precision for all practical purposes. The columns were in a building being erected by the Aberthaw Construction Company for the Boston Woven Hose and Rubber Company, at Cambridge, Mass.

The first column was poured entirely in nine minutes by means of dump cars; the mixture being one part cement to 2½ parts sand and 3 parts of crushed stone (1-in crusher run). The mixture was fairly wet but no effort was made to get anything except a natural working condition. The second column happened to

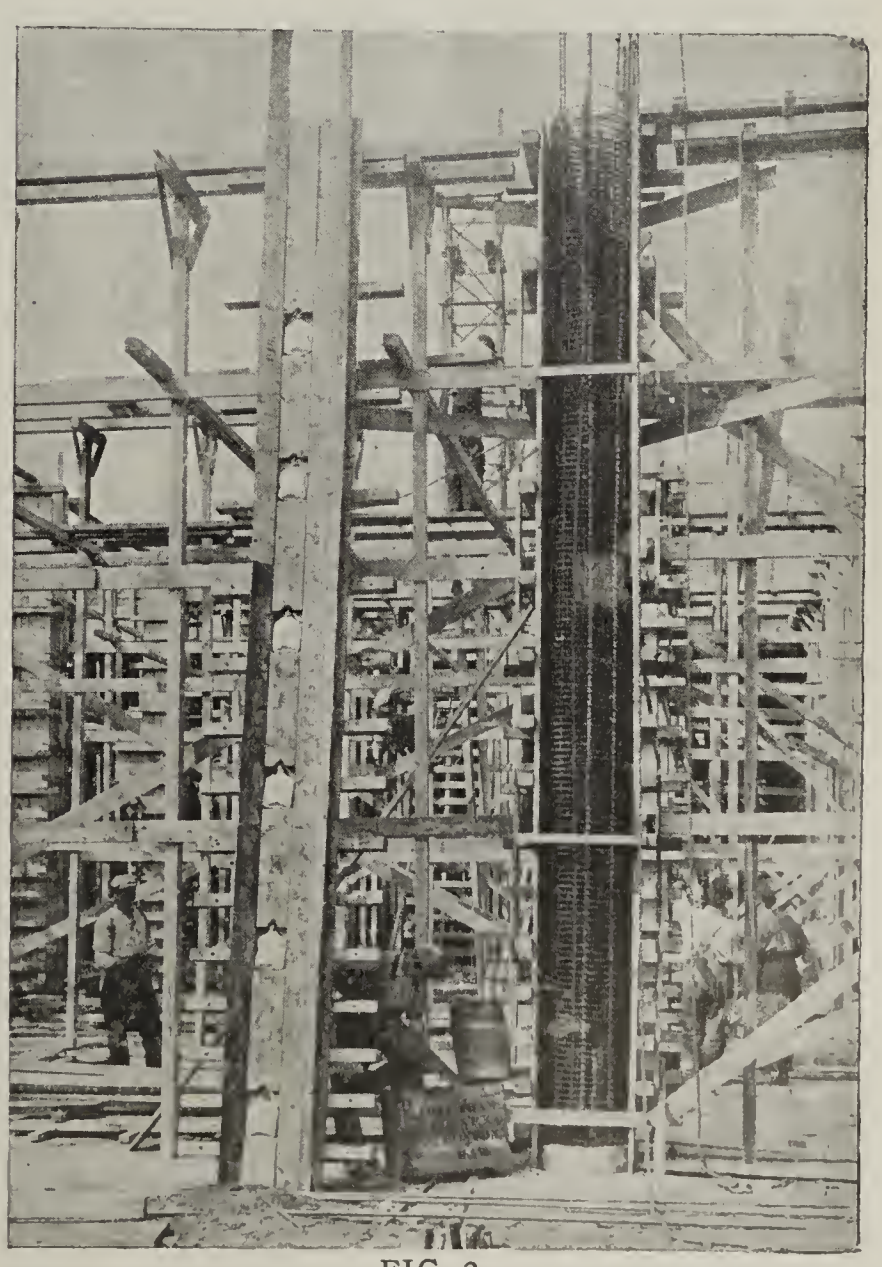


FIG. 2.

be one designed for carrying a water tank. As a result, the mixture was quite rich, being one part cement to one part sand and one part crushed stone. This column was poured entirely in fourteen minutes. The size of stone and relative amount of water were about the same as in the first column.

In each case the highest point of the mercury column was read, this representing, of course, the maximum pressure. The results obtained are shown in the accompanying table where the pressure in pounds per square foot was found by multiplying the reading of the mercury column by the proper constant. The "hydraulic equivalent" is the quotient of pressure divided by heat.

Table Showing Pressure in Concrete Columns During Concrete Placing.

Description of concrete	Column	Head (ft.)	Pressure (lb. per sq. ft.)	Hydraulic equivalent (lb. per cu. ft.)
Time of pouring—9 min. Mixture—1: 1½: 3 Stone—1-in. run-of-crusher Weight of mixture, 152 lb. per cu. ft.	No. 1	3.08	460	149
		6.08	900	148
		9.08	1330	146
		12.08	1710	142
		15.08	2110	140
		18.08	Tube broke	
Time of pouring—14 min. Mixture—1: 1: 1 Stone—1-in. run-of-crusher Weight of mixture—149 lb. per cu. ft.	No. 2	2.75	407	148
		5.75	840	146
		8.75	1280	146
		11.75	1700	145
		14.75	2080	141
		17.75	2450	138

These results checked each other quite closely. It is seen that the green concrete exerts a pressure nearly equal to that of a perfect fluid, and this in spite of the type of reinforcing (pitch of spirals 1½ in.) used on these columns. The pressures in the lower part of the columns do not show quite full liquid pressure, due to the fact that the first concrete put in begins to set before the last concrete is poured.

FIRE TESTS OF PARTITIONS FOR BUILDINGS

The Division of Buildings, of the Department of Public Safety, Cleveland, Ohio, has conducted a series of tests of different types of partitions for buildings (at the request of the Lathing Contractors Association), testing their resistance to fire and to the subsequent action of streams of water from fire hose. The panels were 10x8 feet, built into steel frames hinged as to be swung against an opening in a furnace fired by oil. The fire test was for two hours, after which the panel was swung back and a stream of water was thrown on it for one minute from a hose connected to a city hydrant and having a 1⅛-inch nozzle. The tests were made under the direction of a committee appointed by V. D. Allen, Inspector of Buildings. The committee was composed of L. H. Miller, an engineer of the Bethlehem Steel Company; Prof. Nelson, of the Case School of Applied Science, and Wm. S. Lougee, architect. The Division of Buildings was represented by A. W. Zesiger, Engineer of Construction, who has checked for us the accompanying abstract of the results.

The panels were allowed to set for two weeks before being tested. Their construction and the results of the tests are described below:

Panel No. 1—This was of No. 24 painted expanded metal lath stapled to 2x4-inch pine studs, 12 inch center to center, plastered with a cement and lime plaster on ¾-inch grounds, about 5½ inches thick over all. It took 30 minutes to bring the temperature up to 1700° F., and for the remaining 1½ hours it ranged between 1700° and 2000°, the maximum reached being 1912°. At the end of the two hours, the door was thrown back and water from a city hydrant was directed against the hot panel through a 1⅛-inch nozzle within one minute after the door was opened. After cooling, the metal lath and plaster was torn down to see what had been the effect on the wood studs and outside of wall. What was left of the studding was charcoal, but the outside of the wall was intact and in a condition to resist more fire.

Panel No. 2—This was of white pine lath on wood studding, 16 inches center to center, plastered with a patent gypsum plaster on ¾-inch grounds. The fire reached a maximum temperature of 1865°, but in less than an hour all but the outside shell of plaster was destroyed and that was gradually cracking and opening up; this allowed the cold air to enter the chamber, with the result that it held together long enough to give it the two hours' fire. After the water had been thrown on it, there was practically nothing left of the panel.

Panel No. 3—This had painted No. 24 expanded metal lath wired to ¾-inch steel channel studs spaced 12 inches center to center, plastered on both sides with lime and cement mixture, making a solid wall 2 inches thick. The grounds were ¾-inch thick on the lath side and ½-inch on the other side. On this partition the maximum temperature was 1929°. When water was thrown upon it, with the exception of the washing off of a thin layer of the plaster (that had recalcined under the intense heat) the partition had the appearance of being able to go through another such test.

Panel No. 4—This was a stucco wall such as would be built with metal lath and cement plaster for the outside wall of a house. The metal lath was fastened direct to the 2x4-inch pine studding, then plastered and back-plastered between the studs, giving a thickness of 1½ inch. This side, corresponding to the outside of a house, was placed next to the fire, as it was desired to learn how far this construction might prevent the spread of a conflagration through a residential district. On the outer side of the studding, which would correspond to the inner side of the wall, No. 24 metal lath was fastened and plastered the same as panel No. 1.

The mixture of the cement plaster was particularly designed to prevent hair cracks and other imperfections to which stucco walls under alternating weather conditions are subject when not properly built. It seemed to stand the abuse about as well as, if not better than, panel No. 1. The furnace was fired the full two hours, the highest temperature reached being 1943°, and water was then poured upon it. After the test the fire side of panel (representing the exterior of a house) was intact; on tearing off this side after cooling, the wood studding was found in much better condition than in panel No. 1.

Panel No. 5—This was made by wiring metal lath on both sides of a studding 2½ inches over all, built by fastening two ¾-inch steel channels together. The cement plaster was applied to both sides alike, as in panel No. 1, with ¾-inch grounds, thus making a -inch hollow metal lath partition. The temperature reached 1976°. The metal lath was slightly exposed on the inside of the wall, but it was thought the test might have been repeated before the partition would be destroyed, as the outside of the wall had received no damage and the fire side was good for service to protect the outside from heat.

Panel No. 6—This was ⅜-inch plaster board nailed to 2x4-inch pine studding. The plaster was put on ¾-inch grounds in three coats. This panel had a total fire test of 74 minutes at a maximum temperature of 1562°. Then water was allowed to flow on it at low pressure to quench the fire in the panel, after which the full stream was turned on for half a minute, with the result that practically nothing was left of the panel.

CONCRETE BRIDGES IN PITTSBURGH

Since 1908 a large volumne of bridge construction has been carried on by the city of Pittsburgh. Questions of utility and economy of maintenance and design were given special consideration and the choice of reinforced concrete was partly due to the engineers in charge of the city's construction and partly to the people themselves, to whom the problems were submitted. There are seventy-eight bridges within the corporate limits of Pittsburgh with spans varying from 20 to 800 feet and the approximate value of these is estimated at five million dollars.

The Larimer Avenue Bridge, one of Pittsburgh's finest structures and the largest which has yet been built of this type, was illustrated in the Cement and Engineering News for June 1913. Another large bridge recently completed is at Atherton Avenue over a wide shallow valley containing the Pennsylvania Railway tracks. This, with another recent bridge of similar proportions, forms a new gateway toward the suburbs east of Pittsburgh.

The bridge is 376 feet in length, 60 feet in width and has a 36-foot roadway and two 12-foot sidewalks. There are three duplicate 98-foot spans with 30-inch crowns and depths of 9 feet at the springing lines. The arches are on a skew of over 60 degrees with both piers and railway tracks. There were involved in the bridge 8,700 cubic yards of concrete and over 250 tons of steel. The cost to the city was about $95,000.

The method of construction was rather unusual. The centering consisted of steel trusses spaced 5½ feet apart, forming three-hinged arches upon which the concrete arch rings were built. Sufficient steel was fabricated to cast half the width of the bridge at one time and after the completion of the first half they were moved transversely about 28 feet, permitting the second half to be built. The trusses were supported on timber sills and blocking placed close to the pier faces but not supported on them.

Concrete was mixed in a plant adjacent to the tracks, elevated in a tower 110 feet high and chuted directly to the forms. Concreting was carried on at the three arches simultaneously.

The haunches over the arches were filled with granulated slag which was unloaded from cars into the hoist used for handling concrete and chuted directly into place.

The bridge was designed and built under the direction of the Department of Public Works, J. G. Armstrong, Director; N. S. Sprague, Superintendent, and T. J. Wilkerson, Division Engineer. The Cranford Construction Company was the contractor, with B. S. Tredway, Superintendent in charge. The steel centering was fabricated by the Blaw Steel Construction Company, of Pittsburgh.

ATHERTON AVENUE BRIDGE, PITTSBURGH, PA.
Cranford Construction Company, Contractors.

ELECTRIC CABLE DRILLS IN A CEMENT QUARRY

By F. L. Jorgensen

About six years ago a new Quarry was opened by the Glens Falls Portland Cement Company on the bank of the Hudson river.

This quarry was worked for approximately three years before there was made room enough between the face and the river to throw a big tonnage of stone. Therefore, at that time small blasts were necessary and the well known tripod drills, operated either by air or steam, were used for drilling 1½-inch holes 12 feet to 14 feet deep.

Two such drills were kept working steadily to supply the mill with approximately 650 tons of stone per day. As we got further away from the river the height of our ledge increased to sixty-five feet and we had to make about five blasts in order to bring the rock down from top to bottom. The drill crews consisted of two men to each drill. In spite of the many different changes and methods tried, a lot of broken up stone would fall down on the shelf, at each blast, and had to be cleared off by laborers before the drills could get room to start drilling for the next shot. The slight dipping of the layers, of course, had more or less influence on the amount of stone which had to be cleared. This extra work, together with rather expensive drilling, caused our quarry cost to run rather high, and it was decided to try blast holes of greater diameter and depth as soon as we had room enough between the ledge and the river to blast down the whole face. No shelf cleaning would then be needed, and thus, the laborers employed at this work eliminated.

Finally, about two years ago, we bought a Keystone Well Drill equipped for six-inch holes. When looking into the matter it was decided that the most economical solution of the problem for us would be to buy a machine driven by a motor, since the electric current and wires to which we could couple up the motor, were already available. The actual power consumption would be a very small item and only one man would be necessary to run the outfit, while we figured that two men would be required to run a steam driven machine, and the last mentioned outfit would also cause some extra expense for hauling coal and water, which would amount to quite a little per year.

Therefore, a machine with a variable speed induction motor was ordered. The motor could be connected to our electric wires at three different poles on which the power line was strung. The motor wire was rolled up on a drum. When the machine arrived, we borrowed a man from the Keystone Driller Company to break in the man whom we intended to train for the job as driller. As stated, only one man was to be used, and we selected a steady, reliable laborer who had never seen a well drill before, and who had never made more than about $2.00 per day. We believed, and it proved correct, that in a few days he would be able to run this machine without the slightest trouble, because the conditions of drilling would always be practically the same, as it would not even be necessary for him to fish up a lost tool. In case a drill should get away from him, the lost tool would show up in the next blast.

The speed at which we could expect to get the holes drilled was shown by the borrowed drill runner to be thirty to thirty-five feet per day, including moving of machine from hole to hole under ordinary conditions. With this as base, we offered our man nine cents per foot. He is thus able to make fifty to one hundred per cent more money than he had ever made before, we get our drilling done at a very low figure, and the arrangement has resulted in mutual satisfaction. The drills are sharpened for him at the mill's blacksmiths' shop.

The total cost for drilling averages less than fifteen cents per foot, which cost includes repairs, oil, power, driller, etc. The material drilled is all stone, the overburden being all stripped off. The rock consists of a mixture of slate and hard limestone. I should say that seventy-five per cent of it is the latter, while the rest is fairly soft slate. There has never been a minute's trouble with this outfit since it was installed, and it has been one of the best dividend payers the writer has ever seen. The actual reduction in our quarry payroll, due to the adoption of this method of quarrying and drilling is between $12,000 and $15,000 per year. How much we are saving by less labor troubles on account of fewer men, I will not attempt to estimate. Of the above mentioned saving approximately $2,000 per year is the saving in cost of drilling, while $10,000 to $13,000 is due to avoidance of bench cleaning, track moving, etc. As we are quarrying about 650 tons of stone per day, the saving due to well drilling is about eight cents per ton. Quite an interest on an expenditure of less than $2,000.

We were afraid at the time we installed the Keystone Well Drill that the consumption of explosives would increase, not alone for the initial blasting, but also for the breaking of the expected big boulders. However, we were pleasantly surprised to see that no extra expense appeared; in fact, we are using exactly the same total amount of dynamite per ton of stone now as we used before the well drilling and big blasts were adopted.

While we had been drilling one and a half-inch holes, six feet back from face, six feet apart and twelve feet deep, we now drill six-inch holes, twenty feet back, twenty feet apart, and clear to the bottom (sixty-five feet at present), and the rock is broken up just as well by the latter as the former method. We use about 500 pounds of forty per cent Red Cross dynamite per hole, and blast from four to twelve holes at a time. While, of course, big hole blasting has been used extensively for years in other localities, the local quarries, however, had not seen it done before, and people in the neighborhood were quite worried on account of the expected shock. A man located about one-half mile away was claiming that we would spoil all his incubator output, but no shock or shaking took place, and the chicken man had his eggs all hatched as usual.

Our State Mining & Quarry Inspector stated to the writer that he was very well pleased because we had adopted this quarry method, as the chances for accidents would be reduced to the minimum, because the blasting would take place very seldom, and when it did take place, more attention and care would be shown by the men loading the holes. I also want to mention that, in order to drill six-inch blast holes for our supply of 650 tons of stone per day, the Keystone Well Drill only has to work half the time. Therefore, we arrange to do all our drilling in the summer months and we give the driller other work to do the rest of the year.

It is a pleasure to me to make the above statements. I thoroughly believe that the well drills are the only drills which should be considered for quarry work, when some special local condition does not absolutely prevent their use. While I think that a motor driven machine should be used wherever electric current can be secured, I do not hesitate to say that the heavier steam outfit with the extra man for firing, will show up to nearly as surprising an advantage when compared with the steam or air driven tripod machines which have been worked so extensively in the past.

Th accompanying photographs show our machine working on the top of our ledge. I also want to mention that all our loading of stone is done by hand on piece work. We blast the stone from the ledge and break up the biggest boulders for the loaders. Then the men break and load the stone into cars. That very little breaking has to be done can easily be seen when it is known that we pay our men ten cents a ton for breaking and loading, and that the men nearly every day make about $2.50 per day in less than ten hours.

I have illustrated above what a Keystone Well Drill actually has done for my company, and it is very easily seen and understood that when a steam shovel is used, the advantage of the Well Drill must necessarily be so much greater that nobody could afford to install anything else in connection with a steam shovel.

SEARS, ROEBUCK & CO. ADOPT CONCRETE AS STANDARD CONSTRUCTION

The early buildings of Sears, Roebuck & Co., at Chicago, were of mill construction with cast iron columns. Several years ago they erected a printing building of concrete beams and girder type and as a result of its satisfactory service and reasonable cost added, during 1912, three more buildings all of concrete. The reinforced concrete construction of these three was designed by Condron & Co., Structural Engineers of Chicago, who control the Akme System.

The two new buildings which are illustrated in this article are the manufacturing building No. 1 and the grocery warehouse. The former is 200 feet by 125 feet in plan and of five stories. The grocery warehouse is 325 feet by 129 feet and of six stories and basement.

The grocery warehouse was originally designed for five stories, but after the contract was let and work started, a sixth story was added. It was required that columns should not be of a diameter greater than 24 inches, and steel columns encased in concrete are used in the basement and first story, above which the columns are of the usual type of hooped concrete. There is a triangular shaped two-story extension to the main building on the south.

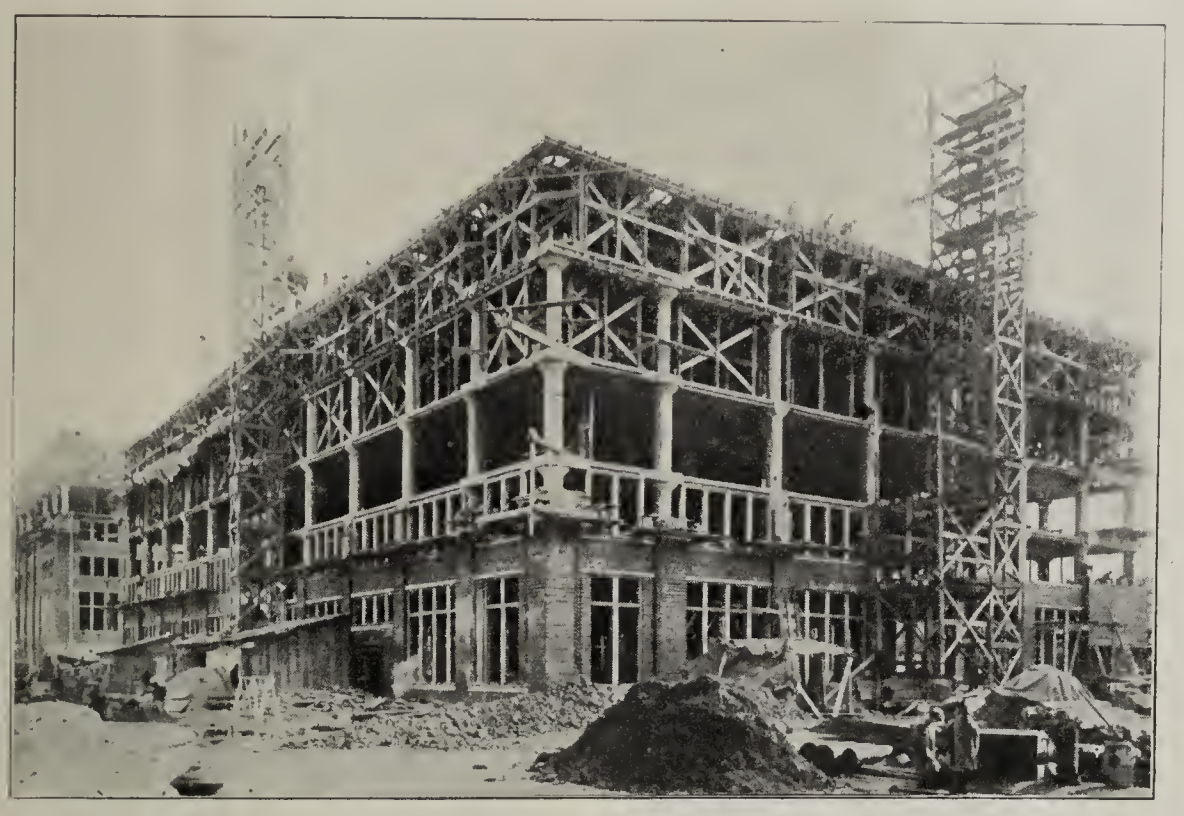
One reason for the adoption of the flat slab type of construction was the saving in head room. The new buildings were adjacent to the older structures and the

old story heights had to be maintained. There was a sprinkler system to be installed and other piping which took considerable head room and the flat slab was adopted in order that the pipes running in either direction might be placed close to the ceiling, thus allowing maximum storage capacity. The reason for the adoption of reinforced concrete rather than mill construction was the need for sanitary as well as rat-proof buildings, which concrete met perfectly. The insurance rate on the new buildings is decidedly low.

The contractor's concreting plant was compactly arranged. A railway siding allowed cars to be brought to the site and both sand and crushed stone were shoveled directly into bins from which they were chuted to the mixer. Concrete was discharged into a dump bucket which in turn was hoisted to the required level and dumped into hand cars, which were operated over runways supported on horses.

At the completion of the new concrete group at the Chicago plant the Condron Company was retained by the architect to design the structural features of the first building of a group to be built at Kansas City for Sears, Roebuck & Co., at a cost of $3,000,000. The first section entails an expenditure of $425,000.

George C. Nimmons, architect, of Chicago, designed the several Chicago buildings and also the contemplated Kansas City structure. Wells Bros. Company, also of Chicago, is the general contractor for the several Chicago buildings.



Manufacturing Building No. 1, Sears, Roebuck & Co., Chicago. Geo. C. Nimmons, Architect; Wells Brothers Co., General Contractors. 200 ft. x 125 ft., five stories. (Grocery Building in background.)

The interior appears to have been plastered but such care was used in form construction that the clean, even results apparent in the illustration were obtained without plastering. The white color is the result of the use of cold water paint but the absence shows the perfection of surface obtained.

In the Akme system the reinforcement is placed in two directions only and concentrated in bands crossing at the columns, the intermediate areas between the bands having much lighter reinforcement. In the illustration on page 151 the bands of reinforcing are shown and also the raising blocks used to hold the reinforcement in place. These are 3 inches square, of varying heights and made of concrete of the same grade as the floor. Their use makes it unnecessary to remove the usual wood raising blocks during the progress of concreting.

The columns are uniformly spaced 18 feet on centers in both directions. The floor slab is 8½ inches thick with maple flooring on a cinder fill and designed for 250 pounds live load.

The building code of the city of Chicago required a test load of double the live load plus the dead load, amounting in this case to 625 pounds per square foot. This was applied over two panels and the resulting deflection was .39 and .48 of an inch at the centers of the two panels and .38 of an inch at the center point of the double panel, this point corresponding to the center of the girder between loaded panels in the usual beam and girder construction.

It was not possible to cast continuously the large areas involved in these buildings. Boards were placed on edge and braced in position along the center lines of panels where needed to end a day's work and upon resuming concreting the edges were slightly roughened and cleaned but no other attempt made to bond the concrete.

REINFORCED CONCRETE DESIGN

Reinforced Concrete Design is the subject of a new book by O. Faber and P. G. Bowie just received from the printer. Price $3.50. Sent postpaid by Cement and Engineering News upon receipt of money order.

Grocery Building, Sears, Roebuck & Co., Chicago. Second story. Panels 18 ft. x 18 ft. Concrete ceiling and columns painted with cold water paint, no plaster.

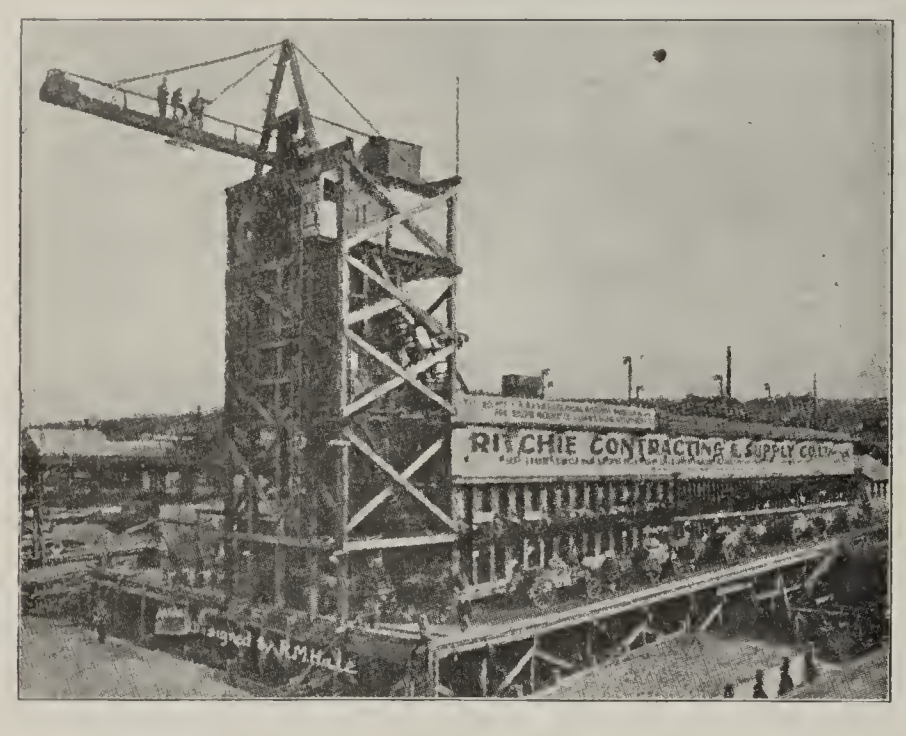
An Economical Plant for Sand and Gravel

Application of Modern Methods to the Solution of Bunker Problems, Vancouver, B. C.

Robert M. Hale.*

The enlargement of the uses of reinforced concrete construction and of plain concrete has so greatly increased the demand for sand and gravel that large modern handling plants are required.

In the East it has not been customary for many years to base the value of any new improvement or article on its first cost; but in the West, where conditions are different, buyers have been prone to consider the first cost of prime importance and have built and bought largely on price. This may have been good policy at one time, when a man bought an article



Unloading Tower and Wagon Way, Showing Boom and Operator's House.

or built a structure with the idea of reaping a rich harvest in a short time and then moving on to some new place. Such conditions are largely due to the migratory population of the West, the desire to move on to new and unsettled parts, and the hope of getting rich quickly by taking the cream and leaving the skimmed milk for those that follow. Today these conditions are gradually changing and those who handle the skimmed milk in an economic and scientific manner are reaping rich harvests.

To handle sand and gravel no special knowledge was required, the object then being merely to build some sort of a box which would hold a few wagon loads. The idea of employing an engineer to study and solve the problems was absurd, as there were no problems to be solved. All that was required was to get a few men and some board and build what was wanted. In fact they often dispensed with even this much by shoveling the material from the bank into the wagons by hand. No one thought of using washed sand or gravel. Timber was plentiful in this country and lumber was the main article in building construction. The rapid increase in population and the desire to build more permanently has tremendously increased the demand for clean sand and gravel.

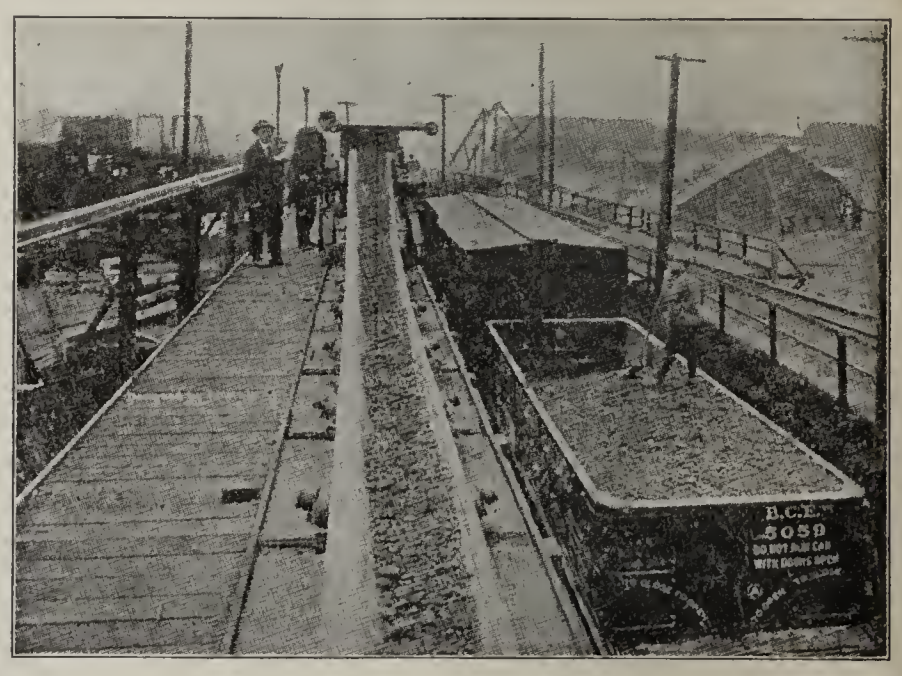
Many of the manufacturing plants and machinery houses, in their great anxiety to increase sales, would offer to design entire plants gratis, provided certain machinery were purchased from them. Their machinery may or may not have been best adapted to meet the requirements of the particular case. The buyer, thinking to get something for nothing, and having no special knowledge of the scientific questions involved, and the salesman thinking only of that particular case, would generally between them get most unsatisfactory results. The buyer, of course, blamed the machinery and the salesman had an unsatisfied customer and peculiar as it may seem neither side could see the wisdom in employing special talent to study the matter.

The machinery often did exactly as the manufacturer guaranteed, so the buyer had no other resource except to shoulder his troubles. The difficulty lay in the fact that neither man had sufficiently keen vision to see all the larger problems involved and to logically deduce correct conclusions therefrom.

Conservative men are today beginning to see the wisdom of employing specialists in each line to solve the problems of economic building and operating.

In designing a plant for any particular use the engineer must take into consideration the peculiarly local conditions governing that situation and must study these carefully and assemble them all logically in his mind before beginning. It won't do to say afterwards, "I forgot that."

When the writer was engaged by the Ritchie Constructing and Supply Company of Vancouver, B. C., as consulting engineer, there were numerous traditional practices to be overcome. When calling for bids under carefully thought out plans and specifications, he was told by a young graduate engineer, representing a large manufacturing establishment, that "unless he conformed more nearly to modern practice his firm declined to bid."



Belt Conveyor for Car Loading at the Sand and Gravel Plant of Ritchie Contracting and Supply Co., Vancouver, B. C. The Link Belt Company, Chicago and Philadelphia, furnished the conveyors and elevators.

The property selected was a long, narrow strip of land on the north shore of False creek, just west of Granville street. The property was excellently situated in regards to delivering materials, being close to the heart of the best business and residence section,

*Mechanical Engineer, Alaska Building, Seattle.

where large quantities of building material were being used. The foreshore was eighteen to twenty feet lower than the street level and the tide had a rise and fall of fourteen feet.

In order not to be obliged to lift the material any higher than necessary, it was decided to establish the dock level just above the maximum high water, and this required that an easy grade be provided to get the loaded teams to the street level. A grade of about 4 per cent was secured. The property was 100 feet by 248 feet on its longest side. The B. C. Electric railway has a branch line running along the back of the property at an angle of 71 degrees 15 minutes with the property line.

The problem of getting the material into the bunkers had to be considered in connection with the problem of getting it out with the least possible delay to teams loading and loaded. Mr. Ritchie desired also to utilize as much of the property as possible for warehouses for the storage of other building materials, such as lime, cement, plaster, etc. He wanted to have built a system which could later on be increased without interfering in any way with the original plant.

For these reasons long, narrow bunkers, with chutes on both sides for loading wagons, was decided upon. In order to prevent a congestion of traffic it was decided to keep all the wagons moving in the same direction, so the empty wagons are brought down a rather steep grade just east of the old Granville street bridge to the level of the foreshore. They pass under the old bridge and under the "out drive," pass by the shipper's office to get their tickets and then onto the driveway on the west side of the bunkers, between the bunkers and the warehouses, showing in above cut. This figure also shows the method of loading wagons described later. They then pass around the front of the bunkers to the west side, where they strike the grade that lands them on the old bridge at the street level. Between the bridge and the Ritchie property is a space of 75 feet, 50 feet of which is occupied by a contractor, and it was impossible to interfere with his operations. The wagons can be loaded on either side of the bunkers, as conditions of traffic warrant. Any heavy truck coming into the warehouses with loads can, by slightly longer road and easier grade, get on the "in dive" with the regular traffic. Most of the material for the warehouses comes either by water or rail and is now unloaded directly.

It was at first determined to build a small 600-yard bunker, but soon after that was finished the demands of the trade were such that it became necessary to increase the capacity to 800 yards by adding some cribbing on the top.

In determining the type of bunkers and the method of unloading many points had to be taken into consideration. First was the character and topography of the ground. Second, the contemplated increase in the size of the plant without interruption to existing operations at the time of enlarging. Third, provision of ample roadways for handling the increased traffic with the least congestion. This involved having the traffic move in the same direction. Fourth, the grade up which this traffic had to be moved to the street level. Fifth, the problem of getting scows to and from the bunkers and storing them without encroaching on the channel fairway. Scows can only come in and out at high tide on account of the shallowness of the channel.

The conditions of traffic largely determined the type of bunker. On account of the trade it was not feasible to use the flat bottom, elevator construction bunker, with wagons driving underneath to receive their loads from above. This type is cheaper to construct, but it had the disadvantage of not adapting itself to the future contemplated uses and increase. Any type of bunker which involves the stopping and backing of wagons into stalls to receive their loads could not be considered here. Hence it was decided by the process of elimination to adopt the type of bunker with outwardly sloping bottom, which type permits the wagons to drive along either side and stop without interfering with the traffic, and receive their loads by means of hinged chutes and suitable gates.

By the same process the type of unloading apparatus was determined. Probably the simplest and least expensive of all to operate is the inclined railway, which has cars that run under hopper bottom scows to receive their loads and are then hauled up the incline by means of a hoisting engine having a direct pull on the cables, with long, easy bends. This is the easiest on the cables, requires less men to operate, has a cheaper and simpler hoisting rig and cleans the scows to better advantage. It has the disadvantage of no flexibility and limits the plant to large and expensive specially constructed scows, so that in an emergency the company could not go into the market and buy material on board any available kind of scow. These heavy scows are also dangerous and hard to tow in a seaway. In order to get into False creek the scows have to cross English bay, which body of water is apt to be quite rough, and this might delay the arrival of material at a time when most needed. This system was not adapted to this particular piece of property.

Another type is that employing a stiff leg derrick with a swinging boom. In some cases the derrick is mounted on the dock level alongside the bunkers and is either stationary or moves on a runway. In others it is mounted on top of the bunkers and may be stationary or travel lengthwise of the bunkers. In still others it is mounted on a level between the dock and the top of the bunkers and may be stationary or travel between two sets of bins or alongside of one. Where it is stationary between the dock and the top of the bunkers, the material must be delivered into a hopper, from which it is taken by some form of conveyor and lifted the rest of the way. Usually some special condition determines the use of one of these forms, but there were no such conditions in this case in favor of adopting one of these types, while there were several against doing so.

On account of the desire to utilize every inch of ground space to the best advantage, it was out of the question to mount the derrick on the dock level. For the same reason it was not feasible to unload scows along the sides of the property, and this eliminated the traveling derrick. Scows must be unloaded from the end of the dock, and this required a stationary apparatus of some kind. The choice lay between a swinging boom derrick and a fixed horizontal boom. The latter was finally determined on as the more economical and satisfactory under existing conditions.

In front of the bunkers and over the space used by the teams in going around from the in to the out drive, a heavy tower was built 30 feet wide (same width as bunkers) by 20 feet deep and 62 feet from the dock level to the bottom of the boom. On top of this tower was built an "A" frame, from which was suspended, by hog rods, a boom, on which ran the trolley carrying the bucket in and out of the tower. All strains were carefully calculated and analyzed and by means of heavy tie rods and struts were carried down to the foundations.

The boom projects 32 feet beyond the face of the tower and is composed of two 8 by 16 timbers, 60 feet long, bolted together and reinforced with steel plates. The trolley is operated along this boom by the

difference in tension on the two bucket lines. The closing line tends constantly to haul it in while the holding line tends to haul it out.

The trolley has a line from the rear passing directly to the inner end of the boom, thence over a large sheave and down to a grooved drum to which it is fastened. From the front of the trolley a line passes to the outer end of the boom, over a large sheave and back to the inner end of the boom and thence down to the same drum, but on the opposite side. When the trolley moves the line winds up on one side and unwinds on the other.

This drum has a brake operated by a foot lever, which is constantly in tension and holds the trolley rigidly in place.

The closing line of the bucket, the one which carries the loaded bucket, passes over a large sheave, in the trolley, and thence directly back to the inner end of the room, then over a sheave and down to its winding drum. The holding line, which lowers the empty

By pressing down on the foot lever the operator winding on the holding line and presses the foot brake. This releases the trolley and it runs out along the boom to the desired position. He then releases the holding line friction and lowers the bucket. He catches it with the brake on the holding line. To hoist he releases the holding line brake and throws in closing line friction.

By this system the number of levers is cut down by one and could be cut down by two were it not for the human equation. A two-drum hoist is used in place of the usual three drum. The operator has four levers to look after, two frictions and two brakes (the one on the closing line being seldom used), and one foot lever.

The hoist is operated by a 50 horsepower A. C. constant speed motor, and when once started needs no further attention on the part of the operator. This leaves him free to devote his entire attention to three hand levers and one foot brake. With a variable speed motor and a three-drum hoist this plant would require two operators in the tower.

Reinforced concrete bridge recently built across the bay at Galveston, Texas, which has 28 spans of 70 ft. each, with a rise of only 9 ft. There are three lines of railway and a 19-ft highway on this bridge, which has also a rolling lift bascule span of 100 ft. at the center.

bucket, passes over a large sheave in the trolley, thence over a sheave at the outer end of the boom, then back to the inner end, over another sheave and down to its winding drum.
releases the brake on the drum holding the trolley lines, and by increasing the tension on closing or holding line can move the bucket in any desired direction and at any required speed. The trolley drum has no friction and the brake is put on largely as a matter of precaution. The bucket can be operated with the holding and closing lines, merely requiring more skill on the part of the operator. To dump the bucket the operator removes his foot from the brake and the trolley stops. He then throws out the friction on the closing line and throws in the friction on the holding line. As soon as the bucket is empty he continues

About 12 feet below the boom the tower is floored over and at this elevation and to one side the operator's house is projected out beyond the tower. The house has windows on three sides, the other being open into the tower, and gives the operator a clear view of the scow and his bucket at all times.

In the center of the tower at this level is a large hopper, into which the operator dumps the material from the bucket. The clam shell bucket is used for digging and hoisting exclusively and not as a means of conveying the material over the bunkers, and by having a hopper into which several bucketfuls can be dumped the bucket is used constantly for what it was intended The remaining space on the operator's floor is used for a store room and a shop for repairs.

On the floor below, which is on a level with the

top of the bunkers, is placed the main hoist and a small hoist for a car haul.

The material is taken out of the hopper on both sides by automatic gates and delivered to the two two-yard cars shown. These cars operate on tracks, which are 13 feet 4 inches centers and 36-inch gauge. The loaded cars run down an incline lengthwise of the bunkers and are dumped over any bin desired. Above the car is a cable running the full length of bunkers and held at the tower end by a heavy counterweight. On the cable is a button which can be easily moved. A forked lever which projects above the car and around the cable, strikes the button with considerable force; this lifts the counterweight and throws the lever over and opens the gates in the bottom of the car. A fixed stop is provided against which the lever strikes on its return journey to the hopper and closes the gates. The tracks are inclined in the tower on a grade of 8 per cent to give the cars a good start, but over the bunkers the grade is changed to 2 per cent.

A 7½ horsepower A. C. constant speed motor operates a two-drum side by side hoist to haul the car back up the incline. All operating levers for the hoist and gates are carried to a platform where a second operator easily controls the distribution of the material in the bins. The operator is protected from the weather, but has a clear view of both cars at all times. The cars travel 156 feet over the top of the bunkers and have proven a most economical method of distributing material.

The main bunkers rest on extra heavy creosoted piling, driven quite close together. Hard pan was encountered close to the surface and the penetration of the piling was only from two to six feet. However, the settlement in a year's time has hardly been perceptible. The bunkers are the framed type, having the bottoms built as a self-contained truss. This simplifies the construction of the balance of the structure.

No special difficulties were encountered in building the plant except inconvenience in handling material. All of the piling and lumber was delivered on scows at once. There was no room on shore on which to pile and frame the lumber, so it was necessary to drive and cap the piles for the warehouse dock and store the lumber there. The rest of the piles were driven as rapidly as possible, and the roadways built. This gave some place to frame the lumber, and when this was done, the erection proceeded rapidly.

Bids were called for for the different sections of the work, but all tenders were so high that it was decided to carry on the work by day labor under the supervision of the engineer. The work was completed at a cost of $1,500 less than the lowest bid.

The bunkers had been in operation but a short time when the business grew to such proportions that Mr. Ritchie decided to proceed with the extension at once.

The original bunkers were designed for delivering into wagons only, but the addition was to be built to deliver into wagons and railway cars. This complicated the problems considerably, as the property did not readily adapt itself to getting in a sidetrack. An additional 100 feet of land was secured to the west of the old property.

It was impossible to get the cars down to the bunkers to load directly on account of the steep grade, so it was necessary to take the material to the cars. The B. C. Electric Railway contemplated some improvements in their trackage, and these had to be taken into consideration. Without going before the railroad commission, a long and tiresome procedure, permission could not be secured to cross Granville street with another track, Mr. Ritchie could not afford to take the chances of delay in going before the commission, so he instructed the engineer to proceed without crossing the street. The sharpest curve which the B. C. Electric would permit had a radius of 151 feet. A lay-out was made showing all feasible arrangements of tracks, and track No. 4 was finally decided upon as having the least objections.

The bunkers were built with a hopper bottom, but sloping towards the center. This gave vastly more storage space, but it did not permit of their being completely emptied by wagons alone, the gates, of course, having to be at fixed height. When the material fell below the level of the gates, some other method of getting it into wagons had to be devised. An emergency hopper was introduced into the conveying system, and the bunkers could then be emptied either into wagons or cars.

Bids were called for for the conveying system under general specifications, it being thought best to leave the details of machinery construction to the various manufacturers.

The conveying system is designed to handle sand, gravel or crushed rock (under 3 inches) at the rate of 100 yards per hour. It consists of two 20-inch belt conveyors, "A" and "B" (p. 572) which run horizontally under the new bunkers their full length of 96 feet and received the material through 48 gates from the bins above. Each conveyor runs independently of the other, so that with either conveyor running the full capacity of the system will be attained. With both conveyors running, the feed is cut down so as not to overload elevator "C."

Both conveyors dump into a common hopper or curved chute and deliver onto the foot of elevator "C." High water comes nearly up to the point of delivery and water is encountered at all times a short distance below the surface of the ground. For this reason the pit was made as shallow as possible, and yet permits sand to run. All conveyors are provided with adjustable brushes at their head ends, to keep the belt clean,

Elevator "C" lifts the material from conveyors "A" and "B" to conveyor "D." The elevator runs at an angle of about 46 degrees, and is of the continuous bucket type with roller bearing chain of 18-inch pitch. It discharges by means of a lubricated spout to conveyor "D" or to the wagon hopper between the conveyor trestle and the spur track.

The conveyor "D" runs horizontally on a trestle above and parallel to the railroad trestle, and has an automatic self-propelled tripper designed to discharge into railroad cars. This tripper has a long-hinged extension spout and delivers the material near the center of the car, thus reducing the amount of trimming required. The extension is pulled up out of the way to permit box cars or the motor car to enter the sidetrack.

The two conveyors under the bunkers are driven by a 7½ horsepower A. C. motor at the head end. The center shaft has two Link Belt disc friction clutches for operating each conveyor separately. Elevator "C" is driven by a 15 horsepower A. C. motor geared directly to the head. Conveyor "D" is driven by a 7½ horsepower A. C. motor, also geared directly to the head. All motors are constant speed. All starting boxes are placed in the tower at the head of the elevator. Push buttons are installed every 12 feet along the entire system, so that the whole apparatus can be shut down quickly from any point in case of accident, the push buttons throwing out an automatic switch. They are started from the tower, however. A system of electric bells is installed, by which

the man on the tripper can regulate the supply of material and communicate with the man under the bunkers.

The addition was rapidly built without any interruption to the operation of the original plant, and no particular difficulties were encountered. It was impossible to drive piles for the bunkers or trestles, so they were built on posts resting on mud sills. Ample surface was given for each footing and some settlement was looked for. Each 12-foot section of the new bunkers carried a load of 450 tons when full, and when the entire bunker was filled the settlement was not excessive. As soon as one section was about finished, the demands of the business were growing so rapidly that it was necessary to use it at once. This made the initial loading on the foundations uneven and more settlement occurred than would have been the case had the loading been more gradual and uniform.

The additional 100 feet of property was bulkheaded and filled in and used for storing brick, tile, reinforcing steel, concrete mixers, and other materials not affected by the weather. Two slips were provided for unloading brick from scows.

Cut on page 573 shows completed plant; the railroad and conveyor trestle and the additional 100 feet of ground before the bulkhead had been built.

The original plant was designed to unload at the rate of 50 yards per hour, but has been doing frequently in the busy season from 60 to 80 yards per hour. The plant is in operation from 14 to 16 hours a day. The completed plant has a storage capacity of 3,200 yards. The conveyors can load cars at the rate of 120 yards per hour. The company has 60 teams and three auto trucks delivering almost constantly, frequently night and day.

The clam shell bucket and cars were designed by Mr. W. L. Newell of Seattle. Mr. Newell also designed the system of handling the bucket lines. The Westerman Iron Works, of Seattle, furnished the clam shell.

The main hoist and car haul were supplied by the Northwestern Iron Works of Seattle.

The Link Belt Company of Chicago furnished the conveyors and elevator. The belts were furnished by the Vancouver Rubber Company, and the motors for the conveyors and elevators by the Canadian Westinghouse.

Mr. E. B. Hussey of Seattle was associate engineer.

The plant was criticised considerably by engineers and those in the gravel business, at first largely because it was a departure from the usual custom in vogue here, but after a year's operation it has economically and satisfactorily handled much more material than was contemplated. It has been heavily overloaded a good bit of the time, but has responded to every demand put upon it. The repair cost has been comparatively insignificant, and the stoppages due to breakdowns very few. The cost of operation has been decidedly low, and were it not for the inconvenience of the tides, this cost could be reduced somewhat. The power cost is less than one-half cent per yard, including all lights for office and night work. It is doubtful if any steam plant can show a better record. It is not exceeded by any plant in the Northwest for its conveniences and economy of operation and first cost.

REINFORCED CONCRETE BUILDINGS

A treatise on the history, patents, designs and erection of the principal parts entering into a modern reinforced concrete building. An excellent and elaborate publication on the subject by E. L. Ransome and A. Saurbrey. Price, $2.50. Sent upon receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

INCREASE IN SAND AND GRAVEL OUTPUT.

With the exception of 1910, last years' production of sand and gravel was the largest in the history of the industry, but the value was the highest ever recorded. The total output of sand and gravel in the United States in 1912, according to an advanced chapter from Mineral Resources on the production of sand and gravel by Ralph W. Stone, just issued by the United States Geological Survey, was 68,318,877 short tons, valued at $23,081,555, as compared with 66,846,959 short tons, valued at $21,158,583, in 1911, and 69,410,436 short tons valued at $21,037,630 in 1910. The increase in quantity last year over that of 1911 was 1,471,918 short tons and in value $1,922,972.

Sand for building purposes constitutes about one-third of the total product. In 1912 the production of building sand was 23,632,157 short tons, valued at $7,904,321, as compared with 24,614,342 short tons, valued at $7,719,286, in 1911, a decrease in production of 1,082,185 short tons, but an increase in value of $185,035 over the output for 1911.

The total production of gravel used for concrete, paving, filter beds, roofing, road-making, railroad ballast, and other purposes in 1912 was 29,768,510 short tons, valued at $7,737,942, in comparison with 26,592,982 short tons, valued at $6,720,083, produced in 1911, an increase in quantity of 3,175,528 short tons and in value of $1,017,859.

Molding sand, which ranks second in quantity and value of production, broke all records in 1912, having for the first time exceeded 4,000,000 tons and passed the two and one--half million dollar mark. The output in 1912 was 4,484,953 short tons, valued at $2,718,398, as compared with 3,376,717 short tons, valued at $2,132,469 in 1911, an increase in quantity of 1,108,236 short tons and in value of $585,020.

The quantity and value of glass sand produced in 1912 was lower than in the two preceding years. The production amounted to 1,465,386 short tons, valued at $1,430,471, as compared with 1,538,666 short tons, valued at $1,543,733, in 1911, a net decrease in quantity of 73,280 short tons, and in value of $113,262.

Grinding and polishing sand had a good market in 1912. The production was 1,397,667 short tons, valued at $667,750, as compared with 938,628 short tons, valued at $521,761, in 1911, an increase in quality of 459,039 short tons and in value of $145,989. Engine sand likewise showed an increase for the year. The figures for 1912 are 1,288,486 short tons, valued at $428,928, an increase of 158,493 short tons and of $17,620 in value over 1911.

In 1911 the production of fire sand and furnace sand amounted to 672,140 short tons, valued at $347,733, and in 1912 to 506,900 short tons, valued at $346,000. Paving sand also was used in smaller quantity in 1912 by 156,042 short tons, but the value nevertheless was greater by $19,071 than in 1911. The output for 1912 was 1,788,530 short tons, valued at $670,680.

A copy of the report may be obtained free on application to the Director of the United States Geological Survey at Washington, D. C.

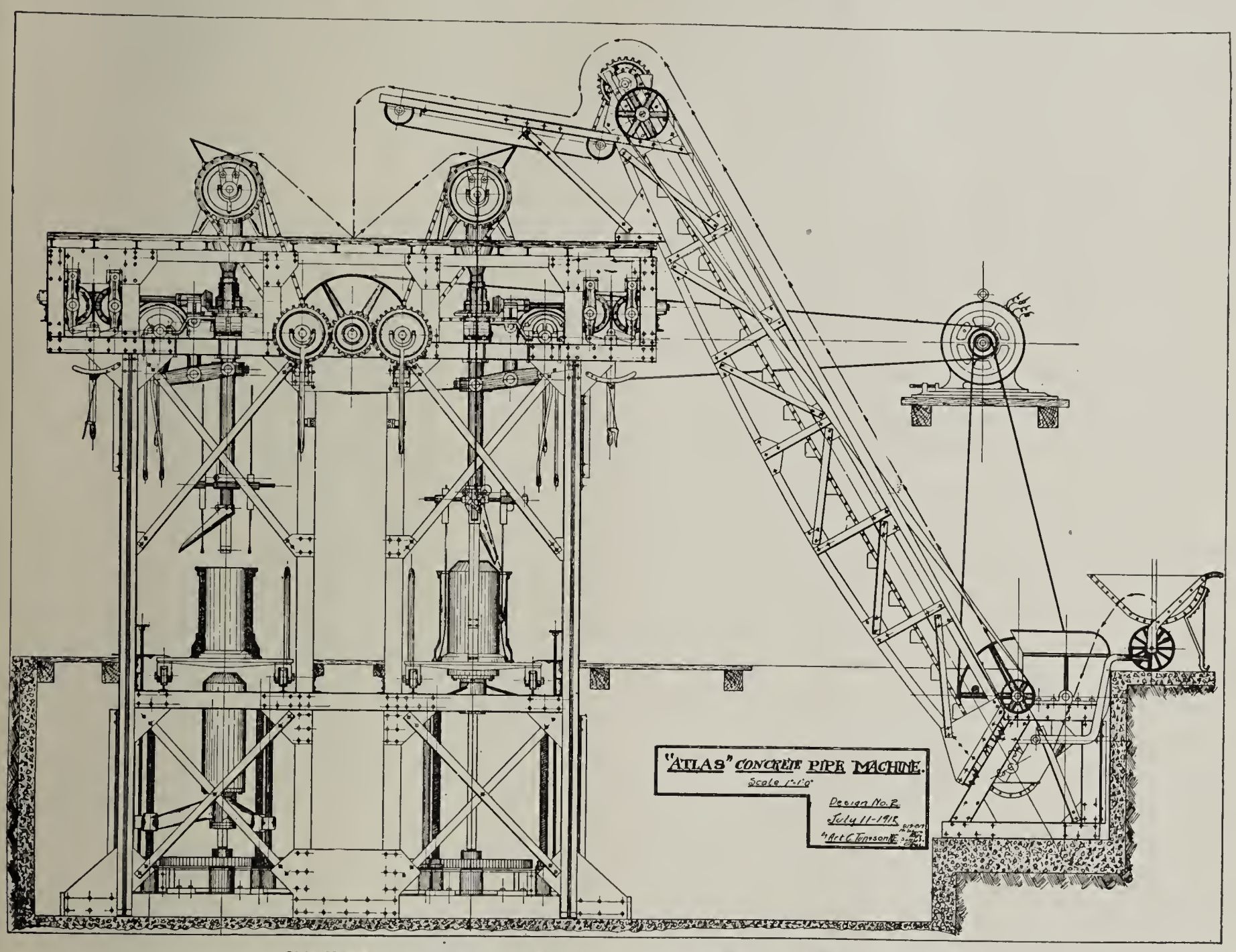
NEWS ITEMS

Although the Sand & Gravel Company, East Liverpool, Ohio., started repairs on their plant about two months ago they did not resume full operation until September 1st. The building and machinery has been repaired and the large derrick and steam shovel put in operation. Large piles of sand and gravel have been prepared for shipment. The plant gives employment to 20 men.

Atlas Concrete Pipe Machine

There is a tendency toward a heavier, more powerful type of machinery in concrete products manufacture and one of the new machinery productions which bears out this tendency is the Atlas pipe machine, made by the Atlas Concrete Pipe Machinery Company, Salt Lake City. In connection with this machine the slogan of the manufacturers is significant: "Costs more to build, costs less to run and does more while it runs."

There are 12 special points to which the manufacturer directs attention, and these are given here practically as stated by the company:



Side Elevation, Showing Machine, Mixer, Conveyor, etc., in Operating Position

The machine weighs 30 tons. It has four rotating flexible steel tampers which strike very powerful blows and produce uniform density from the bell to the spigot end. It is possible to make pipes of extremely wet mixture so that the troweled interior has an impermeable coating that is smooth and true. The "web" on the exterior wall of the pipe is a guarantee of impermeability. The core which does the troweling on the inside rotates independently of the tampers and table and can be operated indefinitely. The core is drawn downward in the same direction as the tamper blow, thus tending to increase the density. Two levers above the head and two at the feet of the operator provide for the easy manipulation of the entire machine. Tables are shifted by pressing a lever with the foot. Tables automatically reduce their speed so that the pipe is not jarred when table stops. No iron rings or pallets are required. By making pipe bell down, the bell-end is made as dense as the cylinder of the pipe. By placing bell ring in table, instead of operating it by hand the output is increased, the quality of the pipe at the bell is perfect and labor is reduced.

Construction of Machine

A side elevation of the machine, mixer, conveyor and so on, is shown herewith. This is a double unit, making two pipe of the same size or different sizes at the same time.

The frame is composed of structural steel channels and angles, rigidly braced by gusset plates and riveted together by compressed air. The frame is in two sections, both identically the same but so arranged that when placed end to end, they may be bolted together to form one solid double frame. The machinery itself is secured to the frame by machine bolts, driven through reamed holes, thereby allowing no lateral motion. All parts of the machine are made extra heavy with extra long bearings of high grade babbitt. The shafts are all turned and are of the best steel and all parts are made to a press fit and are also keyed. All gears are machine cut and of steel, except some of the largest, which are machine-cut of cast iron. Clutches used are of steel with long bearings for the moving parts and brass bushed. Wherever a

collar is used, the set screw is displaced by a steel pin through the collar and shaft and riveted at either end. Some sprocket chain is used but in order to have no trouble from this source, an auto-truck chain of the Whitney type is used and run on steel sprockets. The frictions are of bronze and carry cold rolled steel tampers, to which are riveted steel blades, to which the feet are attached. These blades are used to allow the feet to spring out from the bell ring and tamp the bell of the pipe. These blades are made by the Simonds Saw Co., and are of the very best grade of saw steel. The cores are made of a composition of very hard gray iron, turned and polished. The jackets are made of the best gray iron, machined inside at top and bottom, with a steel plate center rolled to the proper diameter and riveted to the top and bottom castings. They are reinforced along the joint with angles, and are held together by means of an eccentric clamp of special design which may be applied and removed instantly. The carts which are used for carrying the jackets have wood wheels, steel axle, angle frame and pipe handle. They are very simple and durable. The mixer is of the pug-mill type, but has a paddle or blade of a shape peculiar to the needs of the machine. The conveyors are of the belt and bucket type. The feed hoppers are small type pug-mills. The paddles carry the material to one end where a star-shaped steel casting, called a digger, having six spokes, loosens the material and kicks it through the opening into the funnel of the feed pipe. The feed hoppers have thick cast iron heads with steel shell and are bolted together. The tables are heavy cast iron, machined on the face and have roller bearing wheels which run upon a V-shaped track. They are moved backward and forward by means of a worm and gear mounted below to which is attached a crank pin connected to a vertical bar, pivoted at its lower end. By the turning of this worm gear half its circumference, the vertical bar is moved backwards and forwards and each motion moves the table to the extremity of its travel one way or the other. The worm and gear are heavy gray iron castings. An automatic and dirt-proof oiling device is employed by which a constant supply is conveyed through tubes, displacing entirely the open oil or grease cup.

Operation of Machine

By means of a lever convenient to the hand of the operator, the clutch upon the eccentric shaft is engaged, thereby causing the tube situated above the mold to reciprocate or assume an up-and-down motion or stroke. At the same time the friction level, being in its outward position, places the friction wheels against the disc and the tube is caused to revolve around the wall of the pipe. With the aid of a lever, the clutch mounted upon the feed hopper is engaged, thereby causing it to deliver the mixed concrete into the funnel, passing through the tube and spout at the lower end, into the mold. This feed tube revolves with the tampers but does not assume the up and down motion of the tampers. The spout at the lower end of the tube revolves with the tube thereby delivering into the jacket a steady stream of concrete. Upon this material the tampers strike with heavy, rapid blows so that the entire space between the core and the jacket is covered by the four tampers as they travel around the forming pipe—two being close to the core and two next to the jacket.

After an accurately measured batch of sand, gravel and cement has been placed in the mixer and the required amount of water added, the mass is thoroughly mixed in a specially designed open top paddle mixer. With the aid of a lever the entire charge is dropped into the boot of the conveyor from which it is delivered to a platform on the top of the machine. In order to secure perfect regulation of the feed, the material is shoveled from this platform into the feed hoppers.

The beveled bell ring causes the flexible steel tampers to slide off and deliver their blows into the deepest part of the bell, which, with additional moisture and more powerful tamping, is made extremely dense. This tamping process goes on until the pipe is completed and produces a uniform density, beginning with the bell and extending to the spigot end of the pipe. As the material is rammed into the mold, the tampers are forced upward through their frictions until they have reached the top, when the pipe is completed; then the surplus material is struck off and the spigot end of the pipe troweled smoothly.

The core comes up from beneath the table, revolving as it rises. When in position the feed is started and the core continues to revolve during the formation of the pipe. The revolving core trowels the interior surface of the pipe so perfectly that the fine particles of sand and cement are brought to the interior face of the pipe, thereby forming an impermeable surface. This troweling continues until the top has been reached, or as much longer as may be required. The unlimited revolving of the core gives the interior of the pipe a uniform troweling throughout. When the spigot end of the pipe is finished, the revolving core is lowered, by a downward pressure of the foot upon the lever provided for that purpose, and automatically stops below the table.

By means of another foot lever, the tables may be shifted, carrying the finished pipe out from under the machine and placing an empty jacket in position to receive the core. At this point the rotating of the core is reversed and by the pressure of the foot upon the lever, the core is brought up through the table into position in the empty mold, automatically stopping at the top, whereupon the tampers are dropped by releasing the frictions and the operation resumed for the manufacture of another pipe.

When the table shifts, the newly made pipe is in position to be picked up on the forks of a cart, which enables the jacket containing the green pipe to turn bell up on its lugs without the slightest disturbance occurring in the mass of the pipe. The cart then conveys the pipe to the steam curing room where it is set on the floor spigot-end down and the jacket removed. No rings or pallets are necessary to support the pipe as its density holds it in perfect rigidity. A metal band preserves the perfect shape of the bell during the removal of the jacket. This band is allowed to remain on for a short time until the pipe is sufficiently set for its removal.

Capacity

The manufacturers guarantee a capacity for each single unit machine operated by men of average skill and ability, as follows:

4-in. pipe	750′ per 9 hours
6-in. pipe	750′ per 9 hours
8-in. pipe	750′ per 9 hours
10-in. pipe	650′ per 9 hours
12-in. pipe	550′ per 9 hours
15-in. pipe	500′ per 9 hours
18-in. pipe	450′ per 9 hours
21-in. pipe	400′ per 9 hours
24-in. pipe	350′ per 9 hours
30-in. pipe	200′ per 9 hours

The 4-in. and the 6-in. pipe are in 24-in. lengths and the larger sizes in 30-in. lengths. Any two of these quantities are guaranteed with a double unit.

Tests

Tests made of Atlas pipe, by the Kansas City Testing Laboratory, are summarized as follows: 15-in.

internal diameter pipes, 24-in. long with 2-in. bell giving total length of 26 inches, 1½-in. thick, 28 days and made of Iola cement 1 part and Kaw River sand 3 parts, showed an average crushing strength of 2,913 1/3 lbs., or 1,748 1/3 lbs. per lin. ft. The strength required by city specifications is 1,300 lbs. per lin. ft.

Hydrostatic tests were made as follows:

	Pipe No. 1	Pipe No. 2
Internal diameter	12″	8″
Thickness of pipe	1⅜″	1⅛″
Age of pipe	33 days	96 days

Mixture (Composition)—1 part Iola cement to 2½ Kaw River sand.

Results

Lbs. Pressure	Pipe No. 1 (12-in.)	Pipe No. 2 (8-in.)
10	percolation—None	—None (pressure held 5 min.)
20	percolation—None	—None (pressure held 5 min.)
30	percolation—None	—None (pressure held 5 min.)
40	percolation—None	—None (pressure held 5 min.)
60	percolation—None	—Fractured
75	percolation—Fractured	

Required by City Specifications: No percolation up to 10 lbs. per sq. in. pressure—and no fracture up to 33 lbs. pressure per sq. in.—internal pressure.

Drop weight tests were as follows

Pipe, supported on a dry sand bed 2-in. deep, shall withstand without cracking the impact from two blows of a cast-iron ball weighing 10 lbs., falling 18-in. (City Specification for Concrete Sewer Pipe.)

Pipes Tested:

	No. 1	No. 2
Diameter internally	18″	12″
Age of pipe	4 mos.	33 das.

Mixture .....1 cement: 2½ sand

Results

	Pipe No. 1 (18″) 4 mos. old	Pipe No. 2 (12″) 33 das. old
10 pound weight dropped 18 inches, 2 blows	No effect	No effect
10 pound weight dropped 24 inches, 2 blows	No effect	No effect
10 pound weight dropped 36 inches, 2 blows	No effect	Broke
10 pound weight dropped 48 inches, 1 blow	Broke	

Required by City Specifications: Shall withstand cracking from two blows from 10-lb. ball from impact dropping height of 18″.

STEAM CURING CONCRETE PRODUCTS

It is not absolutely necessary to have a steam curing plant in concrete products manufacture. Neither is there any saving in cost of manufacturing, but it is certainly very convenient and makes a material difference in the quality of the product. In the manufacture of block, for instance, we try to get in as much water as we can, but the facing of the block must necessarily be quite dry to prevent its sticking to the face plate. In the body of the block we use all the water it will stand without sagging when removed from the machine. If the facing could be made as wet as the remainder of the block, we should have very good block by allowing them to cure naturally, but the facing being so dry needs a supply of water to complete the chemical action of the cement. Therefore, it becomes necessary to devise a scheme to supply this water immediately after the block is made. If the water is used from a hose it will wash out the cement and thus destroy the face, and if the block is allowed to set the application does no good. But in the steam room a gentle vapor is developed and the block absorb as much as is necessary to complete the action, and a much better block is secured than by any other way I know of, writes C. J. Rowley, manager Builders Concrete Stone Co., Pawtucket, R. I.

I have tried several schemes for steam curing. The first, an open-end pipe taking the steam direct from the boiler, but I found that the steam would rise to the top of the room, and condense and the drops of water fall on the upper block, while those below would secure little or no moisture or heat in the winter time.

Next time (before I had cars) I built a slat floor about 8-in. above the floor of the room and ran steam pipes under the slat floor with pet-cocks about 5-ft. apart. The pipes were directly under each tier of block. This was much more satisfactory than the first attempt, as the pet-cocks are turned toward the cars, the steam rising between the block, and a dense fog is created, which is evenly distributed through the room, every block getting a good supply of moisture. The block come out covered with moisture.

The walls of the steam room are of concrete block and the roof is boarded with matched lumber and covered with tar and gravel roofing. After using this for some time, I found that it was a little unsatisfactory, as the steam would condense on the roof and drip onto the block, thus cutting holes in the faces, so it was necessary to form an arch over each car to make the condensation run off to one side. This is done with galvanized sheet iron curved to form an arch. A board is nailed on the rafter in the center over each car and a strip 2-in. by 3-in. suspended from the ceiling by straps and the iron nailed into the side of the 2-in. by 3-in. and also to the wall. This carries the drippings to the side of the car and they fall on the floor rather than on the block.

The tracks pitch to the delivery end 1-in. in 10-ft., and with this arrangement one man can easily handle a car loaded the steam had to rise between the block and each row got its share while the steam was passing. The first row would set on the slat floor, then we made some jacks or horses, that would straddle the block, by nailing a plank 2-in. by 6-in. on top of uprights 2-in. by 6-in.; placing these about 10-ft. apart, we laid planks across and laid another row of block on the planks, then repeating for the third tier, and so on for as many tiers as the room would hold, keeping the steam on all the time; and for those not using cars, I think this scheme can't be beaten. It is a very simple arrangement and the whole cost was about $400. I had a second-hand boiler and burned about two tons of coal per week. I made 250 block per day with two machines and cured them all in the basement of a house 26-ft. by 40-ft. The basement floor was level with the ground in the yard, so it was necessary to put the boiler in a pit to receive the return water from the pipes. But business developed and it was necessary to build a larger plant which called for the use of cars and tracks.

The steam rooms were designed for an output of about 600 block per day and were made 10-ft. wide, 60-ft. long and 7-ft. high to contain three tracks which accommodate 8 Chase cars each, and each car holds 24 block, making the kiln capacity 576 block, 8-in. by 8-in. by 24-in. The tracks are 2-ft. gauge and 1-ft. apart. The rails are laid in tiers 2-in. by 3-in., 5-ft. apart, then cemented in. Between the tracks is a trench 10-in. deep at the receiving end and 5-in. deep at the delivering end. In this trench are the steam pipes. The feed pipe enters even with the floor and pitches to the delivery end. There are ¼-in. pet-cocks every 5-ft. in the length of the room. The steam is supplied direct

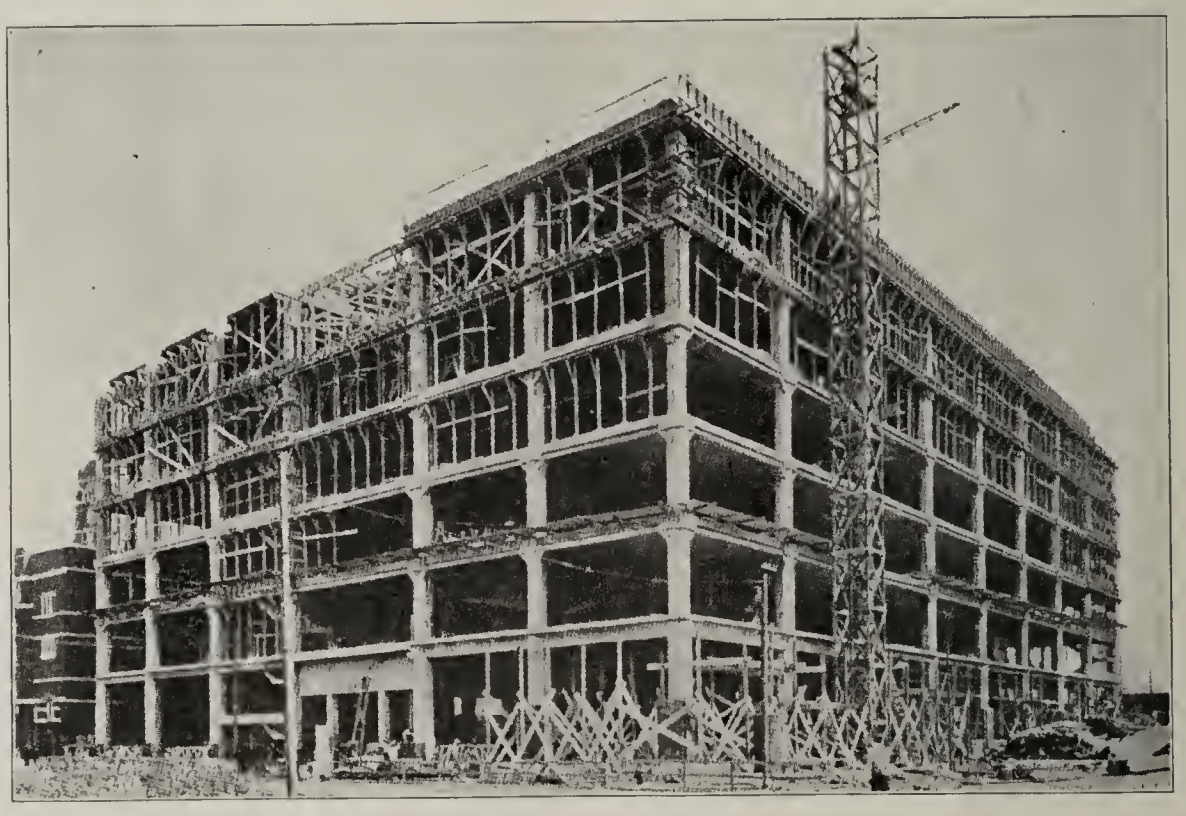
from the boiler through a reducing valve and enters the steam room at 5 lbs. pressure, which is ample. with 24 block, or 2,300 lbs. The doors on the receiving end are made in sections, one door for each track, and are not hung. This allows us to take out a door at a time without losing so much steam as though the whole end of the room were open. On the delivery end, the doors are hung from the roof and a long pole with a weight at the top is fastened to each door. When open it is swung up in the air and forms an awning over the transfer track. The weight on the pole holds the door suspended. When the rooms are closed a canvas curtain is unrolled from the ceiling inside the wooden doors, making it practically air tight. It is essential to stop all draughts, for if draughts are present the steam goes to the top of the room and the lower block are not receiving their share. When putting in the trenches, I had in mind filling the trenches with water and running the steam pipe through the water, bringing the water to the vaporizing point. But the man who installed the steam system convinced me that it would cost too much for coal to heat the water, to be practical. Therefore I abandoned the idea. We have three steam rooms, each containing one day's work. We fill one today, tomorrow the next; next day we fill the third and empty the first; the third day fill the first and empty the second, and so on, leaving the block in the steam room about 48 hours, when they are hard enough to handle nicely without damage.

FORD MOTOR COMPANY'S CHICAGO ASSEMBLING PLANT

The freight charges on the 1913 output of the Ford Motor Company 200,000 machines, will amount to several million dollars. The company's policy of maximum efficiency in every branch has caused a change from the custom of shipping assembled cars to that of shipping parts for assembly at distributing centers. By this method of shipping it was figured that the 10,000 cars allotted to the Chicago branch this year could be placed in Chicago at a saving of $110,000. It would require an assembling plant at Chicago to be operated in connection with the storage facilities and salesrooms necessary under either method of shipment.

This possible saving was sufficient to cause the Ford Motor Company to plan for construction this year twelve reinforced concrete service buildings and assembling plants, for twelve of the largest centers of distribution. Eight are of similar type and designed under the Akme system by the Condron Company of Chicago. The Chicago building is typical, and is a 6-story reinforced concrete flat slab structure covering 38,000 square feet of ground area, 164 feet wide by 230 feet long. The present building is only one-half of the ultimate plan and the present floors extend four feet beyond the column centers on the south where they will join the floors of the new building and form a continuation without change in panel length or distance between footings.

On two sides, the building will present only concrete surfaces and glass. On the other two sides there will be curtain walls. In general the floors are 11 inches thick reinforced with square deformed steel and supported on columns ranging from 40 to 24 inches in diameter with octagonal flared column heads and depressed plates 7 feet square. The story heights range from a little over 20 feet for the first story to 12 feet 11 inches on the upper floors. The area is



FORD MOTOR CO.'S ASSEMBLY PLANT.

divided into 6 north and south and 6 east and west bays; the panels being 25x28 feet except for one bay which required special design in order to bring the railway track within the building. This bay is bounded by columns 35x28 feet on centers; the slab being continuous only over the panel of each floor next the 39th Street side.

A railway track enters the building 4 feet below the second floor level, the track being supported by heavy girder and slab construction carried on the main columns on one side and by a row of small auxiliary columns on the other. The girders are 16.5 feet apart and 7 feet 3 inches deep by 16 inches wide. A 21-inch slab is supported from girders with a clear span of 15 feet 22 inches. The illustration on this page shows this construction from below.

Above the railroad track there will be an enclosed court with a travelling crane of 35-foot span carried on girders at the roof level. The illustration above shows the slabs of the upper floors cantilevered out 8.5 feet from the column centers. Material can thus be handled from the unloading platform on the second floor to any of the floors above.

At the commencement of work a railway trestle which will serve as a permanent siding, was built and is used for bringing in materials. Two receiving hoppers, two storage hoppers and a belt conveyor with a one-yard mixer comprise the mixing plant and the elevated track permitted the side or bottom dump cars to place material into the hoppers without shoveling. To provide against emergency a wagon dumpway was built so that car shortage or railroad strikes would not hinder the work. Concrete is delivered by the mixer into a two-yard hopper, which in turn dumps into a one-yard tower bucket and is elevated to the distributing chute which is sufficiently flexible to cover the entire work.

The chute system is of considerable interest. One tower is situated next the mixer at the south end of the building and another tower is set in the center of the building area. A chute carries concrete from the hopper of the first to the second tower where it runs directly into a second chute which carries it to the forms.

The chutes are built of 8-inch channels placed 12 inches back to back with a sheet steel lining on sides and bottom. They are trussed with cables so as to be self-supporting. The second chute is pivoted at the top to the center of its tower and swings in a complete circle under the guys. A supporting boom of latticed angles rides against a bull ring at the base of the tower so that the distributing chute is entirely supported from its tower and requires no cables.

At intervals of 10 feet there are gated openings in the chute to which flexible delivery pipes may be attached permitting distribution at any distance from the tower.

A second tower consists of the usual wooden structure with a movable steel sleeve carrying the chute. After pouring, the first floor section of the tower is built up for another story and the steel sleeve raised and anchored to the wood tower.

The building stands adjacent to the Kimball building. Each exemplifies the best of modern reinforced concrete construction. The Ford building gives perhaps the greater head room on account of the use of the flat slab and the attachment of sprinklers and shafting will involve somewhat less work. The Ford buildings are designed by John Graham, supervising architect of the Ford Motor Company, Detroit. The reinforced concrete frame was designed by the Condron Company and the contractor is E. L. Scheidelhelm of Chicago.

CORRECTION

We are advised by the Power & Mining Machinery Company, Cudahy, Wis., that the rock crushers installed in the new plant of Three Forks Portland Cement Company at Trident, Montana, are No. 9 and No. 5 McCully gyratory crushers and not No. 8 and No. 5 Gates crushers as erroneously reported in the article concerning this new plant in the September issue of Cement and Engineering News. McCully gyratory crushers are made by the Power & Mining Machinery Company and are being successfully used by many of the largest quarry operators in the country. Two No. 9 McCully crushers with manganese mantles and concaves were installed in the new rock crushing plant at Bruce Mines, Ontario, which was recently built for the S. B. Martins Trap Rock Company.

CRUSHING PLANT OF THE RHYOLITE CRUSHED ROCK COMPANY

With the greatly increased demand for crushed rock of high grade that has arisen during the last three years owing to the growing use of oil macadam and concrete base in building streets and highways and the extended use of reinforced concrete in the construction of buildings, has followed the development of a number of large rock quarries throughout Southern California. While the mountains of rock are generously enough distributed in pretty nearly every section of the southern part of the state the finding of a really desirable rock for crushing is however a prize of great value, for a large percentage of available deposits fail to pass the tests required of crushed rock either for street or reinforced concrete work. Hence the extensive deposits of porphyry immediately east of Corona, Riverside county, noted also for its clays highly valued in the manufacture of brick, tiles, sewer pipe and other vitrified ware, have received considerable attention from crushed rock interests.

Two and a half miles east of Corona the Rhyolite Crushed Rock Company owns thirty-two acres of porphyry, a volcanic rock of great hardness, which it is marketing under the name of Rhyolite. The rock lies in gently sloping hills, lightly covered by decomposed materials which require not more than three feet of stripping. To open up the quarry the company first built a spur track from the Santa Fe main line. The crushing plant was built at the foot of the hill, and the rock is being broken down to the level on which the crushing plant stands. This gives more than a 50-foot face of solid rock. Below this level test holes have been driven thirty feet, still showing continued solid rock of the same quality as the surface rock, so the depth of the deposit is still undetermined.

The rock is broken down by blasting, picked up in skips and hauled by teams to the crushing plant. These skips are of one yard capacity, so constructed that the pan is released from the truck, filled by rolling in the rock again picked up by the two-wheeled truck for transportation to the crusher, where it is automatically dumped.

The crushing plant consists of one No. 10 and two No. 5 gyratory McCully crushers and one No. 3 Gates gyratory type. The rock is carried to the separating screens, to a height of 86 feet, in a 32-inch bucket conveyor. The screens are 5-foot in diameter and 24 feet in length, equipped with dust jacket. The rock is separated into four sizes, not including the dust or finest grade, which is not offered to the market. Aside from the one elevating conveyor the plant is operated entirely by gravity. The bins have a total capacity of 4,500 tons of crushed material and are so arranged that all four or any two of the grades can be mixed to provide any class of material wanted. The bins are built of heavy timbers resting on high concrete foundations through which two channels are provided, one for a railroad track on which cars may be loaded by gravity (a 50-ton car may be loaded in less than five minutes), the other for loading wagons and motor trucks. The latter are coming to be used by contractors having street work of any magnitude in nearby cities. There is also a railroad track at one side of the bins from which railroad cars are also loaded by gravity.

Power for operating the plant is provided from the Pacific Light & Power company's transmission lines. The motor is 750 horse-power. Compressed air for operating the drills is secured from a 75 horsepower Sullivan air compressor plant. The drills are also the Sullivan type.

The plant has been operated since August, 1911. It represents a total investment of about $160,000. Its capacity is 2,000 tons in twenty-four hours, and is being operated at present on a 10-hour per day basis, shipping about 1,000 tons a day. It employs an average of 45 men.

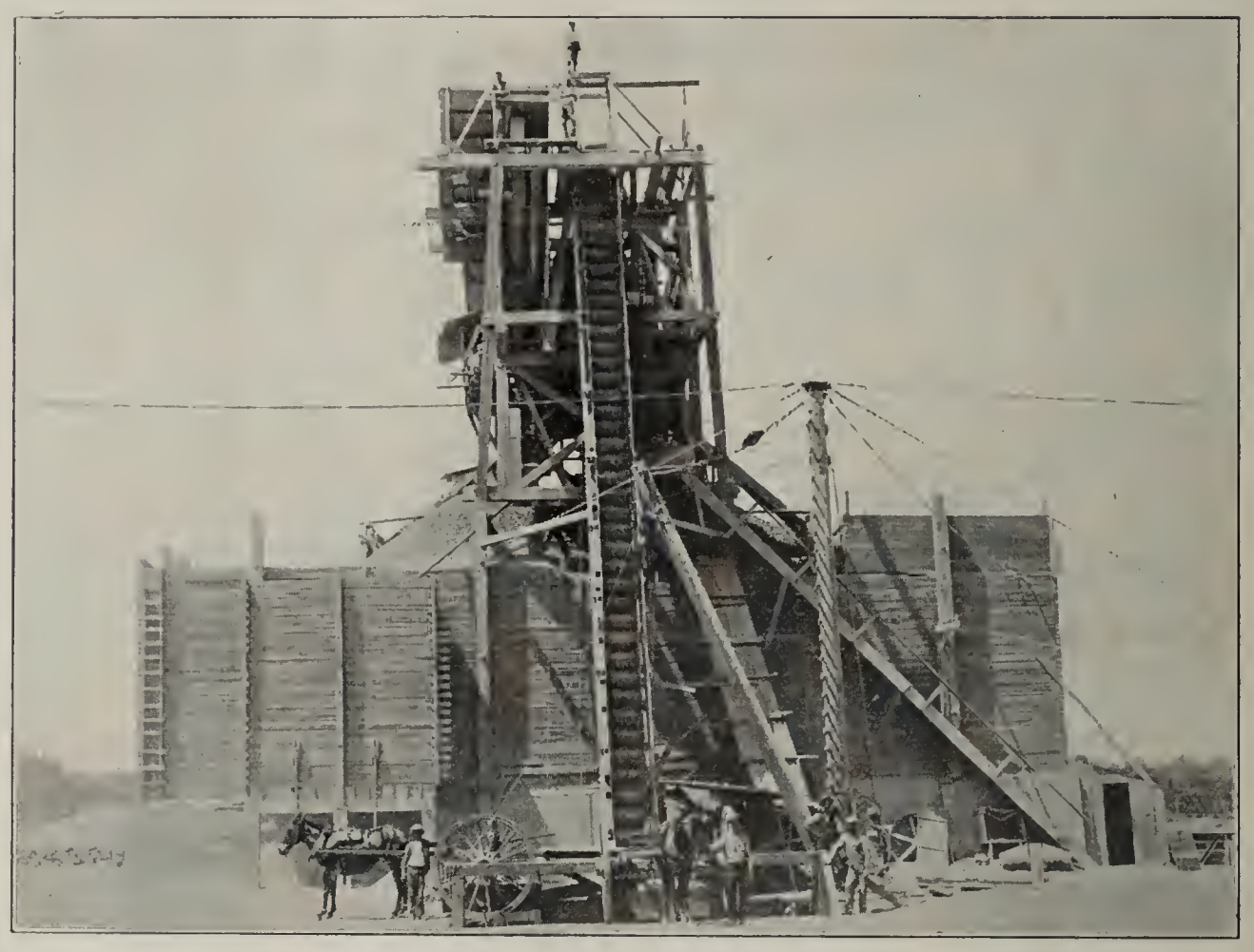
Rhyolite, while possessing great hardness, passing the 2 per cent rattler test, is comparatively easy to run through the crusher. It possesses great durability under the wear and tear of heavy street traffic, and concrete base where it has been subjected to heavy travel for years has been found to be in as good condition as when first laid. Its hardness is suggested by the ability of its sharp edges to cut glass.

The following test and mineral analysis of this rock as a road material is taken from the report of the office of Public Roads, U. S. Department of Agriculture:

Character of Material—Volcanic Rock.

NAME—Rhyolite.

Composition.	Per Cent.
Silicate of alumina and potash. Silica	67.6
Silicate of alumina, lime and soda	15.6
Silicate of alumina, iron magnesia and potash	9.8
Magnetic oxide of iron	1.0
Hydrous silicate of magnesia, iron alumina. Hydrous silicate of alumina.	5.2
Hydrated oxide of iron	.8
	100



RHYOLITE CRUSHING PLANT, SHOWING METHOD OF ELEVATING MATERIAL.
Equipped with three Gyratory Crushers.

Material—Rhyolite (Porphyry)

Determinations:

Specific gravity	2.65
Weight per yard	lbs. 2450
Water absorbed per cu. ft	0.62
Per cent of wear	2.2
French co-efficient of wear	18.0
Hardness	18.2
Toughness	20.0
Cementing value	Good

Hard tough rock with high resistance to wear and good cementing value.

Mineral Analysis	Name.
	Orthoclase
	Quartz
	Plagioclase
	Biotite-hydrous
	Magnetite
	Chlorite
	Kaolin
	Linonite

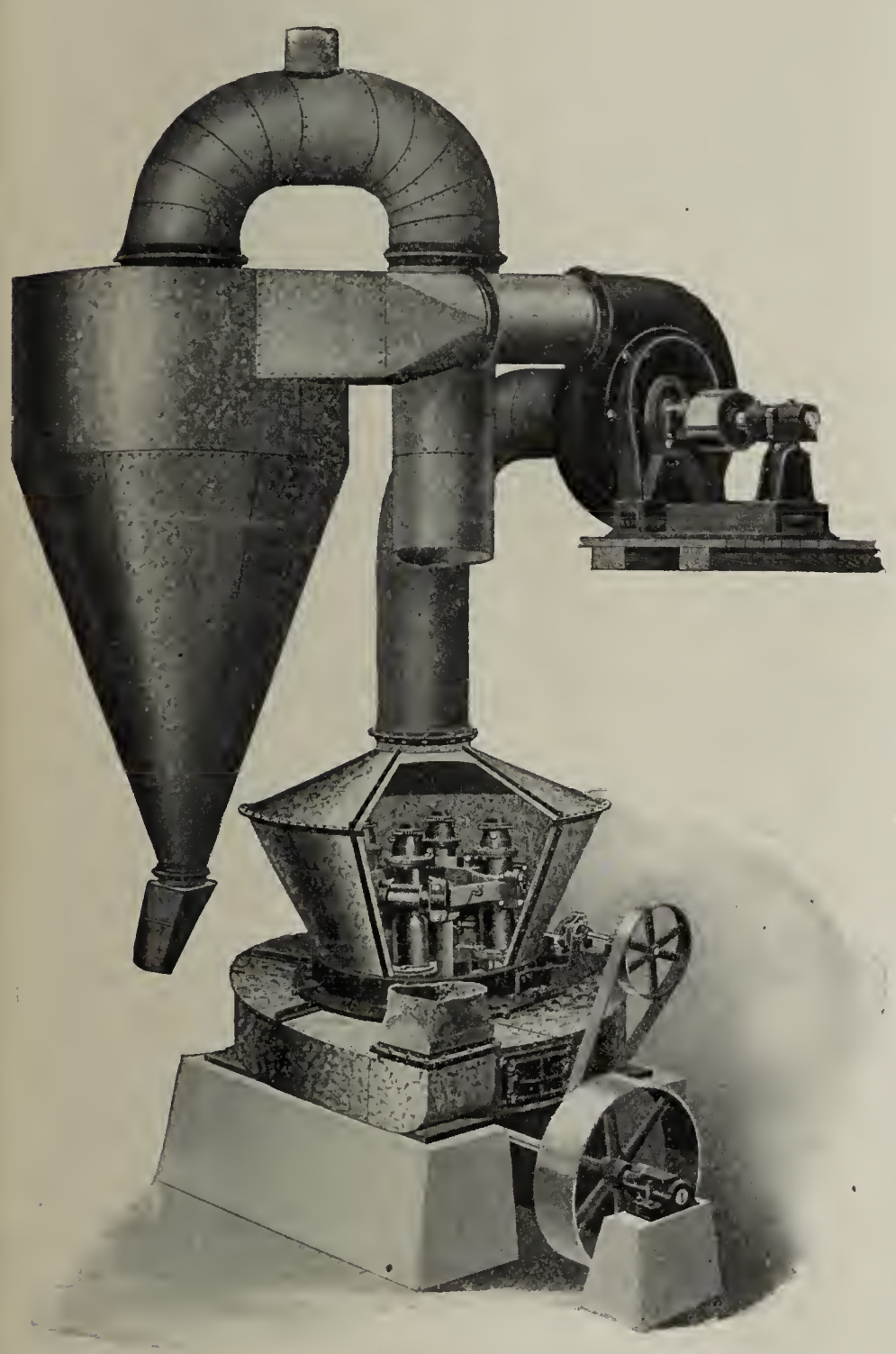
Specimen is very dense, fine-grain porphyrite rock, composed essentially of orthoclase, quartz, plagoclase (oligoclase) and biotite embedded in a ground mass of biotite, quartz and orthoclase.

L. W. PAGE, Director.

The Rhyolite plant furnishes about half the crushed rock being used in San Diego for street work and reinforced concrete buildings. It was used in the improvement of Wilshire boulevard. Slauson avenue and a number of other recently improved streets in Los Angeles, in the construction of twelve miles of the Foothill boulevard section of the county good roads, and several of the new streets at Hermosa Beach, Redondo, Corona, etc. The improvement of Slauson avenue required 28,000 tons. The street department of Los Angeles regularly uses No. 4 grade Rhyolite in resurfacing work. The No. 3 grade, for reinforced concrete work, enters largely into the construction of most of the reinforced concrete structures in this city.

The New Plant of Raymond Bros. Impact Pulverizer Company

Announcement is made of the completion of the new plant of the Raymond Brothers Impact Pulverizer Company at 1309 North Branch street, Chicago. The plant occupies an acre of ground in the heart of the manufacturing district of Chicago, and possesses the best of railroad transportation facilities. A side-track runs into the large machine shop where cars are loaded with the heavy machinery by means of the electric crane which runs the entire length of the shop. The general character of the buildings of the plant is of the highest type of construction, fire-proof throughout, even the roof being of concrete; all windows are of Fenestre steel sash and the fence around the yard is built with concrete posts and creosoted boards.



Raymond Cement Grinding Mill. Several cement companies have recently installed grinding mills and air separators manufactured by the Raymond Bros. Impact Pulverizer Co. of Chicago, and report that they have been very successful. Among late installations are: Crescent Portland Cement Co., Wampum, Pa. (three mills for coal and ten for raw material); Universal Portland Cement Co., Pittsburg plant; Kirkfield Portland Cement Co. of Canada, etc.

The machine shop is 240 feet long by 100 feet wide, containing the numerous drill presses, lathes, planers and boring mills used in the manufacture of pulverizing and air separating machinery which have gained a nation-wide reputation. In this new plant the company has installed additional machinery, all electrically driven, increasing its capacity fully 25 per cent and enabling it to do all its own work, for which it lacked facilities before this plant was built in turning out machinery of the biggest pieces. The "Toledo" electric crane of ten tons capacity runs the entire length of the machine shop.

The floor of the shop is of hardwood maple. The machine shop is lighted with twenty-two 150-watt Tungsten lamps and fifty 40-watt Tungsten lamps placed over the benches. During the day the shop is lighted from the sides and through skylights, making it as light as day. The two side bays are 14 feet to the trusses, the center bay is 30 feet to the trusses and the top of crane rails are 20 feet from the floor. It is heated by hot air, generated in two of the largest Royal Smokeless sectional boilers ever made in Utica, N. Y., and a Sirocco fan, capable of handling 40,000 cubic feet of air per minute. Between 75 to 100 of the highest skilled workmen find employment here.

The building containing the offices, the drafting and reception rooms for the clerical force, is heated by direct radiation and the offices fitted with modern all-steel filing cases made by the Art Metal Manufacturing Company, of Jamestown, N. Y. The stock room is fitted with steel shelving.

The sheet metal is stored in specially constructed racks to economize space, and the machinery is laid out and arranged so that the raw material keeps moving in the direction of the shipping room, which is in the rear of the building adjoining the railroad track.

Raymond Bros. have been in business since 1887, and for the past eleven years were located at Harrison and Laflin streets, moving last May to occupy their new plant on North Branch street, which took one year to complete its erection and which is said to be one of the finest plants of its kind in the country in points of construction, location and shipping facilities. The business of this popular firm, manufacturing pulverizing and air separating machinery, has grown so rapidly that notwithstanding the increased facilities of the new plant it is obliged to run double shifts to execute and promptly ship machinery for which it is continually receiving orders. C. M. Lauritzen, vice president and general manager, stated that they were now in a position to execute the largest orders for machinery they manufacture without any delay, and ship it more promptly than they had ever done in the past.

THE RAYMOND SYSTEM OF GRINDING AND SEPARATING

The Raymond system of grinding and separating has attracted favorable attention as accomplished by the roller mill of that name manufactured by the Raymond Bros. Impact Pulverizer Company, of Chicago. The mill grinds the material finer and more uniform, two qualities that will be easily recognized as being very important by any cement chemist or manufacturer.

It is claimed that in records kept of the fineness daily, extending over a long period, the fineness would not vary a fraction of one per cent. These mills take the material just as it comes from the crusher without any necessity for ball mills or preliminary grinders heretofore used, and in one operation reduce it to

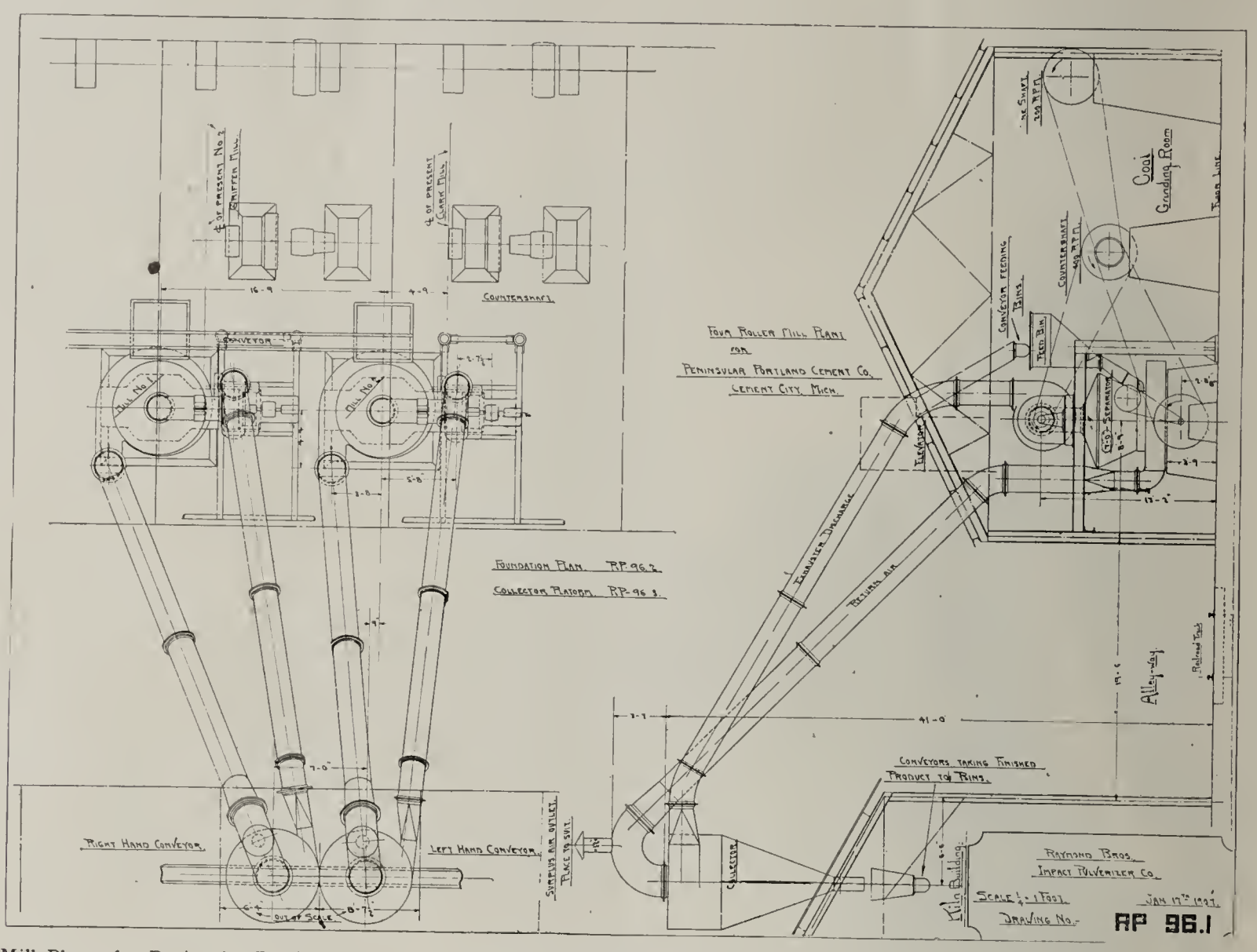
ninety-eight or ninety-nine per cent through 100 mesh or finer, if desired. That is the usual fineness to which the raw material is ground. The mill has also been generally introduced and long used for grinding coal. Some of its good points are dustlessness of operation, which makes it possible for a coal grinding room to be as clean as a private office. Second, the fineness and uniformity of the finished product, which not only saves in the amount of coal necessary to burn a barrel of clinker but improves the quality of cement owing to less ashes. Third, due to the fact that the coal from the mill is discharged at a low temperature, it will not take fire in the stock bins. It will feed more uniformly to the feeding mechanism owing to the uniformity of the particles or fineness of the finished product.

In its operation the Raymond mill crushes and grinds the material by gravity and centrifugal force. A plow is located ahead of each roller and constantly throws a stream of material between the face of the roller and the ring die.

In the mills with air separation, the air enters the mill through a series of tangential openings around the pulverizing chamber directly under the ring die and rollers, and that portion of the material which is reduced to the required fineness by the rollers passing over it once, is instantly carried away by the air current, but that which is not fine enough drops down, is caught by the next plow following and carried between the succeeding roller and ring die to receive like treatment. If the mill is kept properly filled with material, each of the plows will throw a constant stream between the two grinding faces, preventing direct contact of roller and ring die.

In many roller mills the plows or agitators are attached directly to the rollers, which are usually the fastest running part of the mill. In the Raymond Roller mill the casting supporting the plows is attached to the slow-speed upright shaft, and very little power is required to raise the material and throw it between the crushing surfaces of the roller tire and the ring die.

The plows can be removed or adjusted by simply opening one of the doors and without taking the machine apart, and the construction of the mill permits the face of the rollers to remain always parallel with the face of the ring die—a very important feature.



Four Roller Mill Plants for Peninsular Portland Cement Co. at Cement City, Mich., installed by the Raymond Bros. Impact Pulverizer Co. of Chicago.

TIES OF CONCRETE

Concrete for ties for railroads, of such strength and durability that they will long outlast the wooden kind now in use, are being manufactured by the Riverside Portland Cement Company at their plant near Riverside, Cal., and promise to become an important product of this city.

The company has been manufacturing and testing the ties during the last four months. Manager Holiday, who is in charge of the work, states that all are delighted with the success attained.

The ties are of great strength and in severe tests given them have proven their value. Other tests will be made in the near future. Railroad men are greatly interested in these ties and numerous inquiries have been made concerning them.

WOLVERINE PORTLAND CEMENT COMPANY

After running full force since early last spring the large plant of the Wolverine Portland Cement Company, located at Quincy, Mich., was suddenly shut down by L. M. Wing, president of the company of Coldwater, Mich., throwing 150 men out of employment. No explanation is given. The company also has a plant at Coldwater, Mich.

SAND AND GRAVEL WASHER

As every worker in concrete knows, or should know, nothing is so important as clean sand and gravel, and these are often hard to get. There is a machine for washing sand and gravel that has solved completely this problem for every concrete man. It is made by the Stocker Concrete Material Washer Company, Highland, Ill.

The Stocker Gravel and Artificial Stone Company has been operating for years, and, feeling the necessity of a device to clean gravel and sand, Mr. F. Stocker undertook to construct one and finally succeeded in inventing the machine, thereby supplying a want generally felt in the concrete industry.

This machine has been tried thoroughly and found to be practical and advantageous in every respect. Its construction is very simple and strong, most durable and comparatively cheap. It can be readily operated by anyone, since there are no complicated parts to get out of order.

The machine can be easily transported from place to place if desired. This feature is particularly advantageous in case of bridge building, pier and abutment work; in such case the machine can be moved to creek or river bank, where sand and gravel can be found in abundance nearby, however usually too much mixed with mud, dirt or other impurities to permit their use; but if washed right on the spot the cost of hauling the material from a distance, sometimes for miles, is saved.

The washer is all metal, the end frames are cast iron, the revolving drum is of No. 16 sheet steel. On the inside of the drum are riveted angle iron bars, to which steel strips are riveted, forming an elevator carrying the material to the upper part of the drum, whence it drops into steel chutes, which are stationary and at a fixed angle, conveying the material forward; from the chute it falls into water at bottom of the drum, taken up by the elevator and dropped into the next chute and so on until the washed material finally is discharged from the last chute.

The machine can be operated with a 2-horsepower gasoline engine, is well made, strong and durable.

The capacity of the machine is about 75 tons per day of 10 hours, washing sand and gravel containing 20 per cent of clay (result of actual tests) and will require only from 10 to 15 gallons of water per minute. Then, too, the price is within the reach of all. Write them today for prices, catalogues and mention Cement & Engineering News.

"STAG" GEARS

Stag manganese steel gears are used extensively in steel mills, rock crushing plants, cement mills, on conveyors and elevators, in brick plants, ore grinding machinery and in other locations where the service is severe, writes the Edgar Allen American Manganese Steel Company, Chicago. They may be depended upon to last generally eight or ten times as long as ordinary steel gears. The reason for this is the greater strength and toughness of Stag manganese steel, its well known wear resisting qualities and the fact that the teeth wear to a high polish, thus reducing friction. It is, of course, especially valuable in places where dust, sand and grit are in the air, but its use is very profitable in many places free from this feature, for instance, in steel rolling mills.

Cast gears are used mostly, but where spur gears with accurately ground teeth are required we furnish our Electric Special Ground gears. These gears have the teeth ground upon special patented gear-grinding machines, to within .002 of an inch, as to thickness of teeth and pitch diameter.

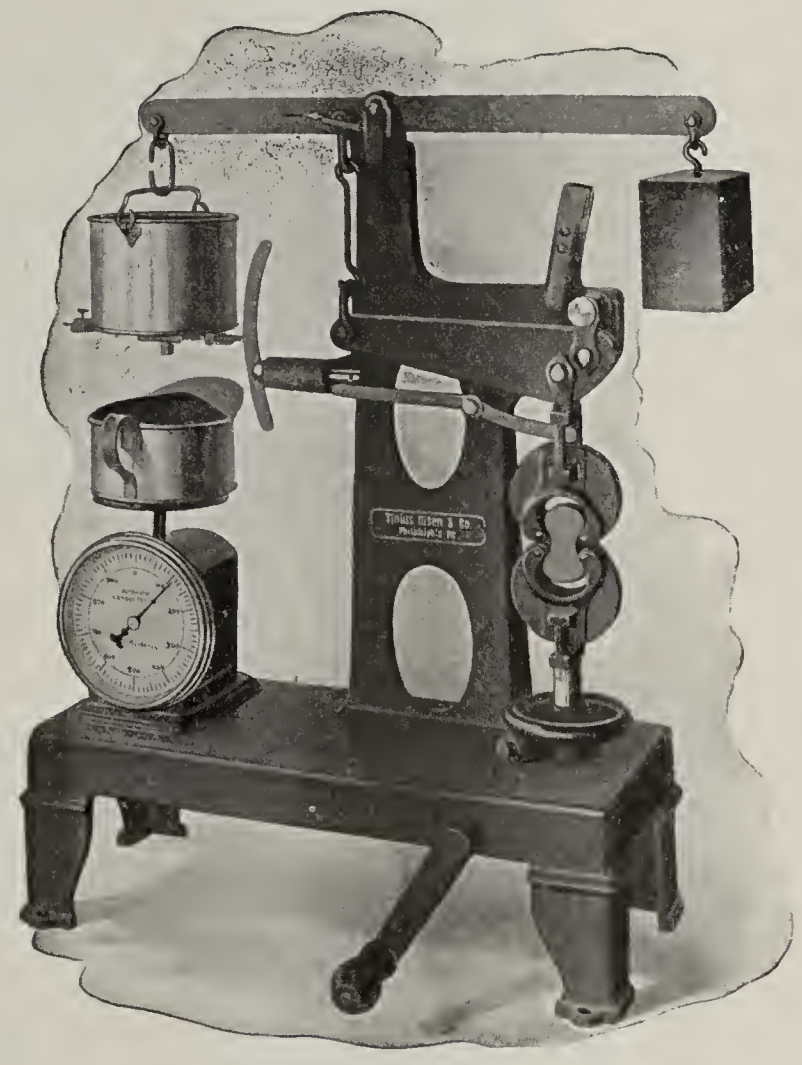
NEW AUTOMATIC SHOT CEMENT TESTING MACHINE 1000 AND 2000 POUNDS CAPACITY

This illustration is of the very latest improved type of New Automatic Shot Cement Tester and is the most up-to-date cement tester made.

To operate the machine first place sufficient shot in the bucket to balance the lever system as indicated by the pointer, then place the briquette in position in the clips taking up the initial load, which may be set at a predetermined point by means of the hand wheel at the base. This forces the bucket end of lever down and gives sufficient lever motion so that when automatic trip is set and the shot is released from the bucket the machine need not be further regulated and thus automatically breaks the briquette.

The trip is set after applying initial load by pressing arc lever until it engages in cut off lever over the upper clip. The shot is released and flow of shot regulated by means of the slide valve and regulator at the base of the bucket. The flow of shot is instantaneously stopped on rupture of the briquette independently of the amount of tension on the briquette.

"Our No. 1 Machine as shown herewith," writes Olsen & Co., the manufacturer, "may either be used absolutely automatic or the lever system may be kept



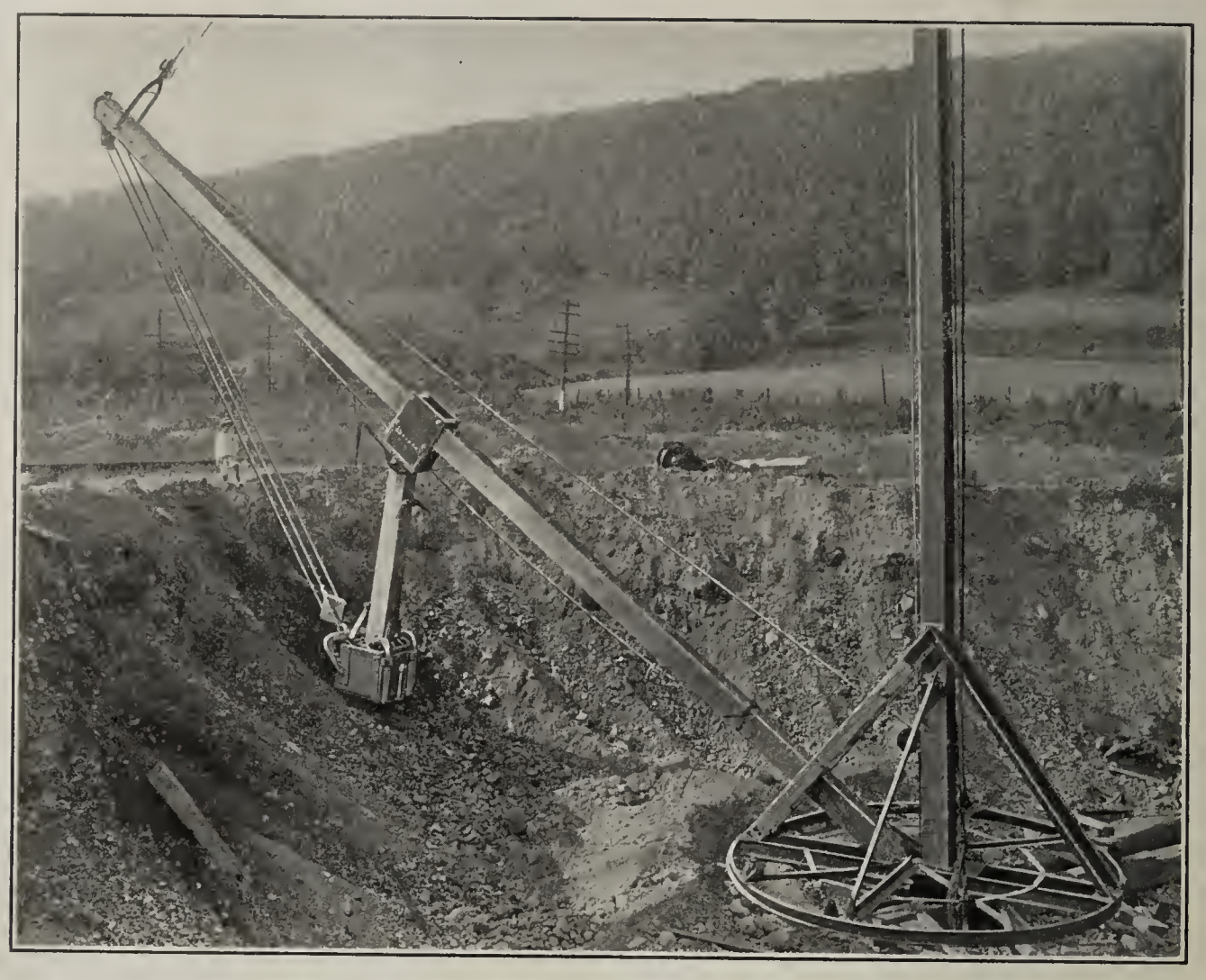
New automatic shot cement tester.

in a horizontal position during the test by turning the crank shown at the base which takes up the motion of the lever system. This device is not essential excepting in our 2000 pounds capacity machine where sufficient lever motion cannot be obtained and it must be taken up by the use of the crank.

"The breaking load is weighed automatically on the scale placed on the frame of the machine so that the operator can watch the application of the load and knows at any instant exactly what load is on the briquette when it breaks and it can thus be jotted down without further manipulation or calculation.

"The small hand wheel for adjusting the lower clip is arranged so that it will automatically slip on the adjusting screw as soon as a predetermined load has been applied to the briquette. This hand wheel having been properly adjusted there can be no strain on the briquette or danger of premature fracture of briquette by further turning the hand wheel.

"This machine has a maximum strength, stiffness and durability and is the most quickly operated cement tester made." Write for prices and catalogs, Olsen & Co., care of Cement & Engineering News, 1117 Schiller Bldg., Chicago.



GENERAL VIEW SHOWING THE OPERATION OF THE BISHOP DERRICK EXCAVATOR.

A NEW DERRICK EXCAVATOR

In digging any material the efficiency of the equipment depends very much upon the weight behind the shovel arm. The Bishop excavator is a dipper on the end of a short arm, operated by a carriage that can be placed on any square derrick boom.

In operation the engine-man slacks gently on the digging line drum until the carriage rolls down the boom, bringing the shovel to the desired position and then releases this entirely. The dipper swings back under the boom, the large end of the cam operating the grip and at the same time the operator lowers the boom, thus bringing the entire weight of the boom on the dipper.

The load can be discharged on top of the bank, into carts, hoppers, bins or cars, as may be desired and the apparatus is arranged to dump by hand line or automatically, as may be desired. The automatic dump accomplished by means of a lever arm rigidly attached to the carriage, which acts on the bell crank attached to the dipper arm. When the shovel is run up near the peak of the boom, and thus bringing the dipper arm almost parallel with the lever arm, throwing it over and thus pulling back the door latch of the shovel, which is attached by a chain or line to the bell crank.

The carriage is constructed entirely of steel plates and contains four rollers, which allow of its easy reciprocation up and down the boom. Between the two side plates and below the rollers is a cross channel, from which is suspended by bolts two plates, one above and one below the stationary wire cable which is attached to the boom at the heel and peak. On these plates are cast-iron grips to hold the carriage to the wire when desired. The end of the dipper stick is provided with a cast-iron eccentric or cam-shaped shoe and when the dipper arm is raised towards the loom, as shown in its dumping position, the pressure is released, and permits the carriage to roll on the boom, but when the dipper arm is released, as shown in the digging position, the large end of the cam or eccentric presses the lower grip plate against the wire and holds the carriage until the dipper stick has been raised sufficiently, when the small end of the cam or eccentric releases the grip, and the carriage follows up the boom.

Only one man is required to operate it with a two-drum engine and swinging gear; one drum is to raise and lower the boom and the other to operate the shovel.

This outfit is manufactured by the Union Iron Works, Erie Siding, Hoboken, N. J., who will be glad to furnish you further information.

NEWS ITEMS

M. D. Schaaf was in Havana, Ill., recently negotiating for the purchase of the cement products plant of which the late S. L. Norton was manager and superintendent. The plant is now owned by local capitalists. Mr. Schaaf is president of the Virginia Timber Company of Peoria, Ill., and is also figuring with the Peoria Mausoleum Company with a view of furnishing the gravel for the mausoleum which is to be built in Havana.

THE HART PARR COMPANY'S FACTORY

Eleven factory buildings of concrete and steel have been built in the last two years by the Hart Parr Company of Charles City, Iowa, builders of high class traction engines. The two accompanying pictures show the general design of them all and the extent to which concrete has been used. They vary greatly in size, from 100x600 feet, 250x270 feet, down to a small storehouse 30x50 feet. They are all of the same general construction. The side walls up to the window level are built of hollow block cast in the well so that there are no joints. This was for the purpose of giving a patterned effect to the otherwise plain surface. Above this level the walls are of reinforced concrete, as are also the roofs and the floors. The roof was given a covering of burlap, laid in asphaltum, with two additional coats over the burlap.

Especially good lighting facilities have been obtained by the use of modern steel sash, and this was helped to a great extent by the type of construction chosen.

The modern factory is now requiring not only the best of machinery and management, but also the best housing. Reinforced concrete has been found by many large manufacturers to best suit their needs. In the building of many large structures such as these it is possible to use forms successively, and often to use the same design and details for not only all parts of the same building, but also for buildings of several sizes. At one time it was generally thought that concrete floors were not suitable for machine shops, but the objections are entirely overcome today and the practice is becoming general. In the buildings of the Hart Parr Company about 15,000 barrels of Universal Portland cement were used.

CONCRETE BUILDINGS OF THE HART PARR CO., CHARLES CITY, IA.

Few people in Keystone, Iowa, have an adequate idea of the work turned out by the Keystone Cement Tile Works. To show that it is an establishment worth considering among the important manufacturing plants of Benton county, it may be stated that this company has shipped, during the present year, twenty-two car loads of cement products, besides selling 25,000 tile to local purchasers. To manufacture these products it required twenty-three car loads of sand and ten car loads of cement.

CONCRETE SHOP BUILDING OF THE HART PARR CO., CHARLES CITY, IA.

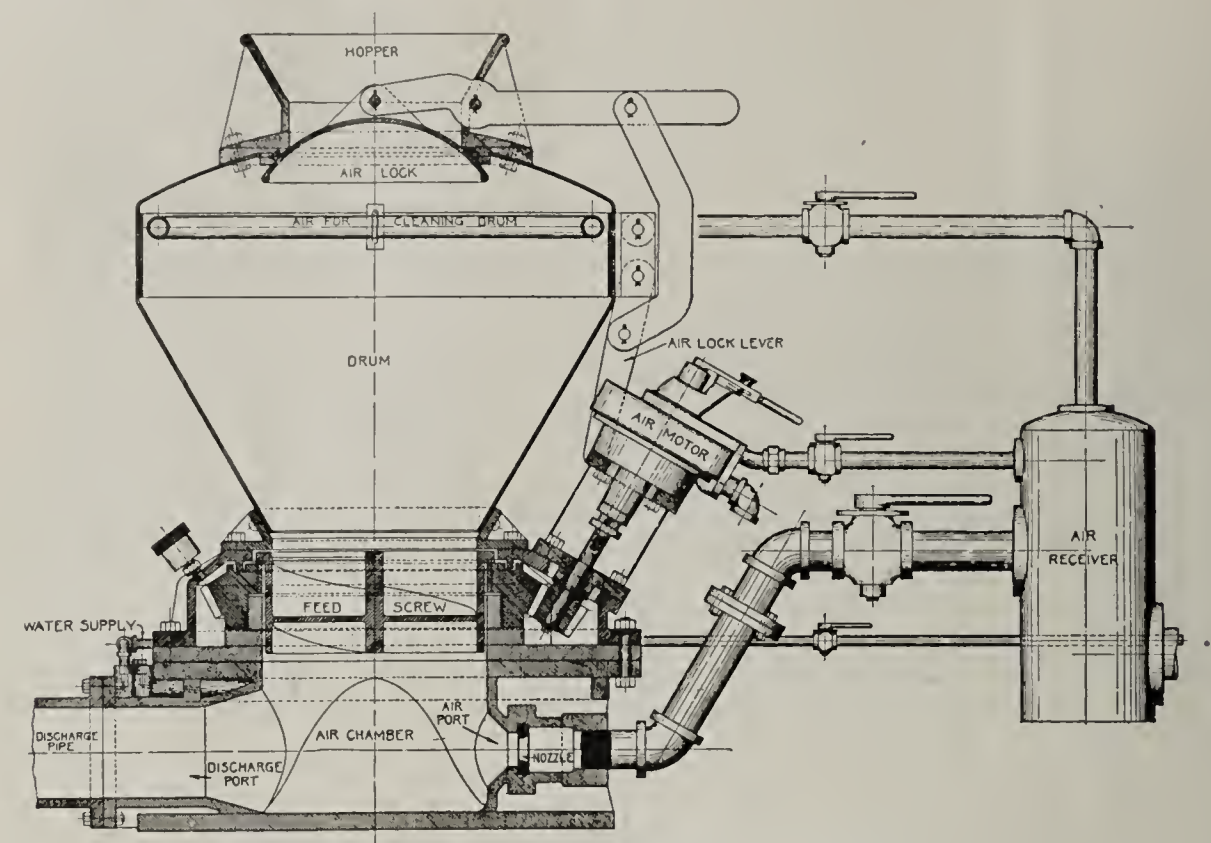
MIXING AND PLACING BY AIR

Pneumatic concreting, grouting and stuccoing machines as manufactured by the Concrete Blower Company, 103 Park avenue, New York, N. Y., are described in a circular recently sent out by this company. It is claimed that the pneumatic concrete blower will mix and place a full batch of concrete in less than one minute and will do this as a continuous operation. With this machine, the progress of the work is dependent on the facilities for feeding the blower, as the conveying is accomplished in a few seconds through a discharge pipe, and as rapidly as the mixing process is carried on.

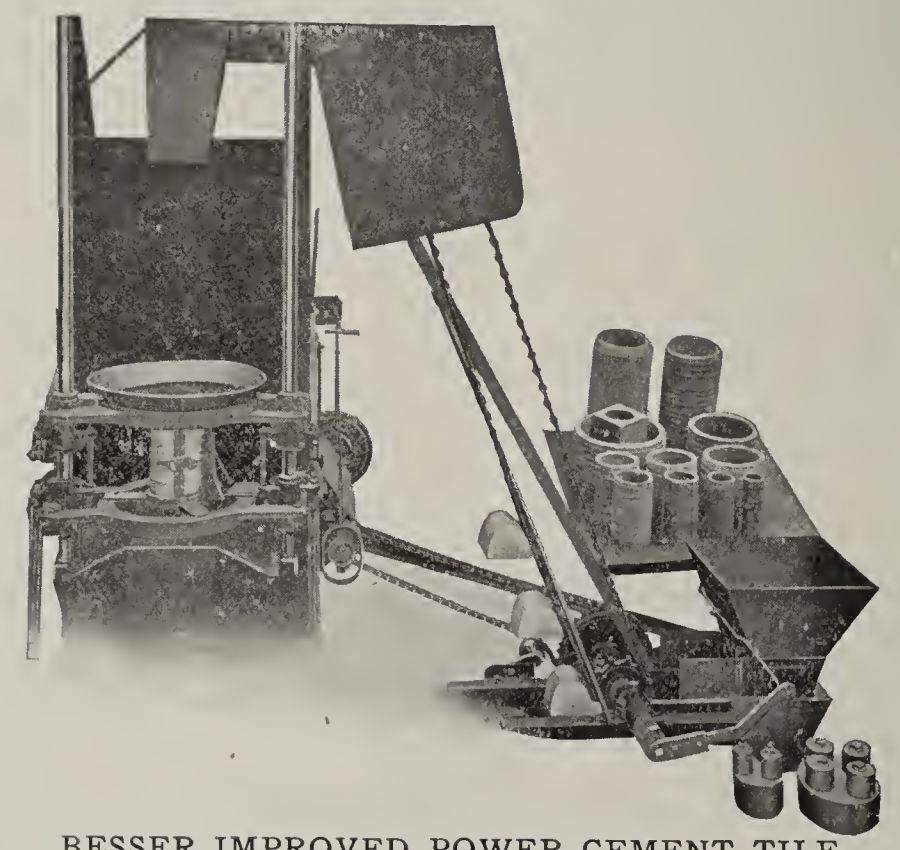
The blower consists of an apparatus composed of a hopper and drum, secured to an air chamber, the dry materials being fed from the hopper to the air current passing through the air chamber by means of a worm rotated by an air motor. Water is added simultaneously with the falling of the dry materials into the air current.

In operation, the dry mixed or unmixed aggregates are placed in the drum of the air-locked door closed. A blast of compressed air is supplied to the receiving chamber through the nozzle. The feeding worm is rotated by the power from the motor, and a stream of water under pressure is passed into the receiving chamber. As the screw revolves, it feeds the aggregates into the air, the addition of water occurring simultaneously, the mixed concrete being absorbed by the air and carried as a stream through the discharge pipe to the place for use. The possibility of the clogging of pipe is eliminated by the means adopted for feeding the dry materials to the air current. To stop the operation, shut off the power at the motor and no material enters the air chamber.

The pneumatic concrete blower will mix and place



PNEUMATIC CONCRETE BLOWER.



BESSER IMPROVED POWER CEMENT TILE MACHINE.

concrete of any size aggregates; it will mix and place concrete composed of cement, sand and torpedo gravel used as a facing in building construction; it will mix and place grout in any desired from, and it will produce concrete for repairing walls, abutments, etc.

Pneumatic concrete blowers are furnished in five sizes, capacities running from 4 to 40 cubic feet.

CEMENT TILE

Progressive men in the concrete products business have found the cement tile manufacture a profitable and satisfactory commercial enterprise.

The manufacture of cement tile is pleasant work; no disagreeable and uncertain burning and like operations. It is an exact science compared to the manufacture of clay tile. No guesswork. Cement, which is the active ingredient, is delivered, fully guaranteed and manufactured by concerns whose operations are so extensive that they can employ the highest priced scientific skill, such as individual tile plants could not afford. Manufacturers of cement tile have the best brains of the country behind them.

Tiling is just beginning. It would take one machine a year to make the product necessary to entirely tile one square mile. Cement tile are a staple article. They are always in demand and readily compete with any clay tile in any locality. The accompanying illustration shows a view of the Besser Improved Power Cement Drain and Sewer Tile Machine manufactured by the Besser Manufacturing Company, 407 Thirteenth street, Alpena, Mich. It is a machine built on principles gained through experience in tile plants. The construction embodies every feature of advantage that perfect mechanical design can demand. In operation the Besser Cement Drain and Sewer Tile Machine is steady and does not cause delays for adjustments. The machine produces tile in all lengths, including 12 inches, 18 inches and 24 inches, with diameter ranging to 18 inches.

NEW STONE-CARRYING STEAMER.

The new stone-carrying steamer which J. B. Ford, of Detroit, will have built for carrying limestone from the quarry of the Michigan Alkali Company to the chemical products plants at Wyandotte, Mich., will cost from $250,000 to $300,000. The contract for the building of the vessel is just about to be let, it is understood, and it will be ready for the opening of navigation in 1914.

The Michigan Alkali Company already has two large boats, the steamers Wyandotte and Alpena carrying stone and cement clinkers from Alpena to Wyandotte, but with the building of a new crushing plant of 6,000 tons daily capacity at the quarry here this will not be enough. The present crushing plant of 4,000 tons daily capacity will be held as a reserve, making the company's possible output of crushed limestone 10,000 tons a day. A new steel dock is being built and a slip is also being constructed to give sufficient dockage for the three large vessels which will be plying from Alpena to Wyandotte next season, and thereafter.

ALLIS-CHALMERS MFG. CO.

Allis-Chalmers Manufacturing Company announces the removal of the Sales and Engineering Offices of their MINING MACHINERY DEPARTMENT from Chicago, Illinois, to the Milwaukee Works at West Allis, on or before October 6th, 1913.

The Chicago shops will also be removed to Milwaukee in the near future.

The advantages to be gained by concentrating all Departments, both commercial and manufacturing, at one plant are the reasons for this move.

Breaking endurance records everywhere it is used

Here are a few striking records which show the kind of service Longlife Belts are giving. We'll be glad to give names of the users and further information on request. "137,000 tons better than any previous belt." "Exceeded former records by 30%." "Beat previous records over 700,000 tons." "Beat previous records made by belts of higher cost." Give

LONGLIFE CONVEYOR BELT

a trial on your hardest conveyor run. Give Longlife Conveyor Belt the chance to show you that it can save you money and give you better service. Select some conveyor where the belts used in the past have not proved satisfactory, try out a Longlife Belt for the job and compare results. Longlife Belt will live up to its name, do better work and save you money. Write for information.

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DEVELOPING A GRAVEL SUPPLY

The question of a suitable gravel supply confronts the contractor on every job he undertakes. Sometimes it is not so much a question of obtaining gravel as of expense; and, at other times, really suitable natural gravel cannot be obtained at any price.

We have long advocated the development of individual gravel plants from standpoints of economy and independence of local conditions. With the machinery now made, it is an easy matter for any contractor to get busy and produce all the gravel he requires at any time. He does not have to wait on the convenience of the man who sells him gravel. He will experience fewer delays, and less dissatisfaction, too. Besides all this, there is the possibility of selling his surplus product at quite a substantial profit, though this is a side issue.

In this connection, we wish to direct the attention of our readers to the possibilities of the "Universal" Crushers. The company manufacturing these produces machines suited to any size of plant. The "force feed" principle of these crushers is one feature which will bear deep thought. With one of these machines, a contractor can crush stone into any sized gravel desired at the rate of from 5 to 300 tons per day of ten hours.

It goes without saying that the mechanism of "Universal" Crushers is simple and strong enough to warrant the best and most economical results. Manganese and crucible steel are used where great strength is required. Space will not allow us to tell you much about the "Universal" line, but the contractor who can foresee the advantages of producing his own gravel will write the Universal Crusher Company, 304 N. Third street, Cedar Rapids, Iowa, for its complete catalogues and circulars. The time spent in studying over this proposition will certainly not be wasted.

McCORMICK WATERPROOF CEMENT

We wish to notify the public that Charles McCormick, our former president, is no longer connected with our company in any official or authoritive capacity, writes the McCormick Waterproof Portland Cement Company of St. Louis, Mo. The company has been reorganized and a new board of directors elected. Mr. James A. Smith, our former vice-president, has been elected as president and general manager. We are preparing to increase the number of our branch offices. The success of our Shamrock Brand Waterproofing Compound also justifies an increase in our mill capacity. Mr. H. C. Morrison is still representing the McCormick Waterproof Portland Cement Company in Chicago and vicinity.

ANNOUNCEMENT TO CONTRACTORS

The Willis Shaw Machinery Co., Chicago, Ill., dealers in Contractors' used machinery and equipment, wish to call the attention of the trade to the fact that they now have a larger stock on hand than ever before.

Owing to the reorganization of their working forces, they are in better position at this time to serve the trade than at any time in their history. They also state that last season's business was the largest they have ever experienced and broke all previous records.

The remarkable growth of the Willis Shaw Machinery Company in the last few years is due in great measure to the new business received on the recommendations of their many satisfied customers.

LOWER RATES ON CRUSHED LIMESTONE IN INDIANA

The Indiana railroad commission has entered an order establishing new rates for all carriers in Indiana on crushed limestone for use as a rebuilder of Indiana farm lands. The new rates are far lower than those now in existence, and in an opinion that takes up the entire question of this sort of development of crop producing lands in Indiana, Chairman Wood and the other members of the commission pointed out the need of immediate action on the part of Indiana farmers to avail themselves of the "inexhaustible supply" of this restorer of land fertility.

The schedule of rates ordered by the commission cuts down the present charges on the product to a scale of 35 cents a ton for hauls of ten miles or under to $1.40 a ton on hauls of 325 to 350 miles, a scale that is slightly higher than the rates on crushed stone and gravel and coal, and also is much higher than the Illinois rate for the same commodity.

The order of the commission is directed against thirty-two railroad companies which operate in the Indiana limestone regions. The list, as set out in the order, includes practically all of the larger roads and systems in Indiana. The order further places the minimum load on cars at 90 per cent of the marked capacity of the car. Where a movement is a joint rate or joint movement, a minimum charge of 25 cents a ton is to be allowed each line, the commission declared.

NEW PLANT OF THE UNIVERSAL PORTLAND CEMENT COMPANY

Substantial progress is being made on the new plant of the Universal Portland Cement Company at New Duluth, Minn. Frost conditions at New Duluth require foundations at least 9 feet deep involving very large quantities of material. Concrete is being mixed in a central mixing plant and hauled to the points where work is in progress, in two car trains each car holding five one-yard buckets. The buckets are picked up by a locomotive crane and dumped into the forms.

One hundred and thirty men are now at work on the plant and this number will be increased as soon as the structures are started. The stock room and machine shop are to be completed first and will be used to house the materials and equipment required for the building of other parts of the plant. Their foundations are complete and the walls are about to be started.

The operation is in charge of the following officials of the Universal Portland Cement Company: Leonard Wesson, Assistant to President; A. G. Carlson, Mechanical Engineer and J. H. Barbazette, Superintendent in charge of construction.

This plant will have a capacity of 1,400,000 barrels of cement per year giving a total output of 13,400,000 barrels.

IMPROVEMENTS AT RIVERSIDE CEMENT PLANT

It is announced by General Manager Tyler Henshaw of the Riverside Portland Cement Company, Riverside, Cal., that his company is expecting to make enlargements in the very near future that will involve an immense expenditure of money and will mean a large increase in the output of the big plant.

CS-111 Chain (¼ size)
Runs on regular No. 111 Combination Chain Wheels

Here's a Good Chain

For Handling Coarse and Gritty Materials,

especially those which have a destructive chemical action on iron and steel.

"*A chain is only as strong as its weakest part,*" and the place where an ordinary Combination Malleable and Steel Chain starts to go to pieces is at the connection between the pins and the steel side bars, where the bearing surface is relatively small.

The tendency of the pins to rock, and wear loose, in the holes of the side bars, will elongate the holes, destroy the pitch, and ruin the chain long before the wear of other parts necessitate throwing the chain away. This is particularly noticeable in a chain subject to destructive chemical action, as in the handling of fertilizers.

The fact that the "CS" class chain has one of the steel side bars and two adjacent pins properly formed in **one piece,** positively overcomes this element of weakness, and greatly increases the working life of the chain as a whole.

The attachments are generally furnished on the Malleable Iron links, and thus comes at even pitches. "K" attachments can be supplied at any intervals required. We can furnish the same attachments as on our "C" class chains, and, with our unsurpassed manufacturing facilities, we can supply the "CS" class chain at the same price, and with the same prompt delivery, as the "C" class chain.

Write to nearest office.

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actually rubs shoulders with the Building Material Problem. Talk it over with him. He will be eloquent on the necessity of using a waterproofing compound which

1--Is Not Hard or Expensive to Mix
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3--Permeates Uniformly Throughout
4--Is Disintegration Proof
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HENCE HE IS THE MAN WHO APPRECIATES

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Among The Cement Mills

Gilbert & Hall, testing and inspecting engineers, 614-616 Couch building, Portland, Ore., has been awarded contract for testing approximately 100,000 barrels of cement to be used by the U. S. engineers in the construction of The Dalles-Celilo canal. The tests, which include chemical as well as physical tests, will be made at the cement mill at Cement, California, where Gilbert & Hall will establish a laboratory. The contract also calls for a large number of special tests of the sand that is to be used in the concrete construction.

A. F. Krabbe, at present superintendent of the Union Portland Cement Company's plant at Devil's Slide, Utah, will go to the Pacific Coast shortly after September 1, to become superintendent of the new plant of the Olympic Portland Cement Company, at Bellingham, Wash. The latter plant is now running both kilns, but is still in charge of the engineers pending a thorough test. The owners expect to assume control about September 1.

Power from the Keokuk dam will commence turning the great wheels in the plant of the Atlas Portland Cement Company, at Ilasco, near Hannibal, Mo., by the first of October next. The transmission lines are now ready for use at the plant, but it will take some time to change the electrical fixtures so that hydro-electric power may be used.

SALE OF CEMENT MILL

Among the bills passed by the last Legislature that become effective is one permitting the city to sell the Monolith cement plant to the county on the installment plan. It is expected that formal action to complete the sale will be taken soon, says the Los Angeles Examiner.

According to a tentative agreement between the county and city officials, the city is to receive $550,000 for the plant, which cost the city about $800,000. The plant was established to manufacture cement for the construction of the aqueduct.

The informal understanding between the city and county is for the latter to pay a part of the price of the plant at once, and this will be used in paying off some of the remaining obligations of the aqueduct. It is believed that much of the future payments will be made in the form of cement that will be used by the city for street improvements. The county is planning to manufacture cement for its good roads system and for sale to the city of Los Angeles and to the State for use in the construction of highways.

BLOUNT MOUNTAIN COMPANY

One of the new companies which is preparing to enter the cement manufacturing field is the Blount Mountain Cement, Coal & Lime Company, with its home office at Birmingham, Ala.

This company owns approximately 3,595 acres of land in Blount, St. Clair and Jefferson counties, Alabama, and the plant which is to be built will be near Village Springs. In addition to the manufacture of Portland cement, it will also provide for the manufacture of lime, hydrated lime and fluxing stone. The capacity for the production of Portland cement will be about 500,000 barrels annually.

The company is incorporated under the laws of the State of Delaware, with a capital stock of $2,000,000, half of which is in common stock with a par value of $50 per share and half in 7 per cent preferred stock with a par value of $50 per share.

NEW ADDITIONS TO THE KOSMOS CEMENT PLANT

The work on the new addition of the Kosmos Portland Cement Company is being pushed to rapid completion. The Dugan Engineering Company, Louisville, Ky., is very much farther ahead with this contract than anticipated. Work was started May 19th and practically all foundations are in; boilers installed; steel work on the ground and kilns being rolled into position. The re-enforced concrete stock house is over half completed. and will be finished by the first of October. The plant should be turned over at its full capacity by January 1st.

NEW BOOKS

The Calcium Silicates and Calcium Aluminates Contained in Portland Cement - - - - - - - 50 Cents

By Dr. O. Schott

The Manufacture of Hydraulic Gypsum and Other Gypsum Products - - - - - - - 50 Cents

By M. Glasenapp

The Hardening Process of Hydraulic Cement
The Hardening of Cement Under Water
The Constitution of Hydraulic Cements
} - 50 Cents Each

By Dr. W. Michaelis, Sr.

How to Use Portland Cement - - - - - 50 Cents

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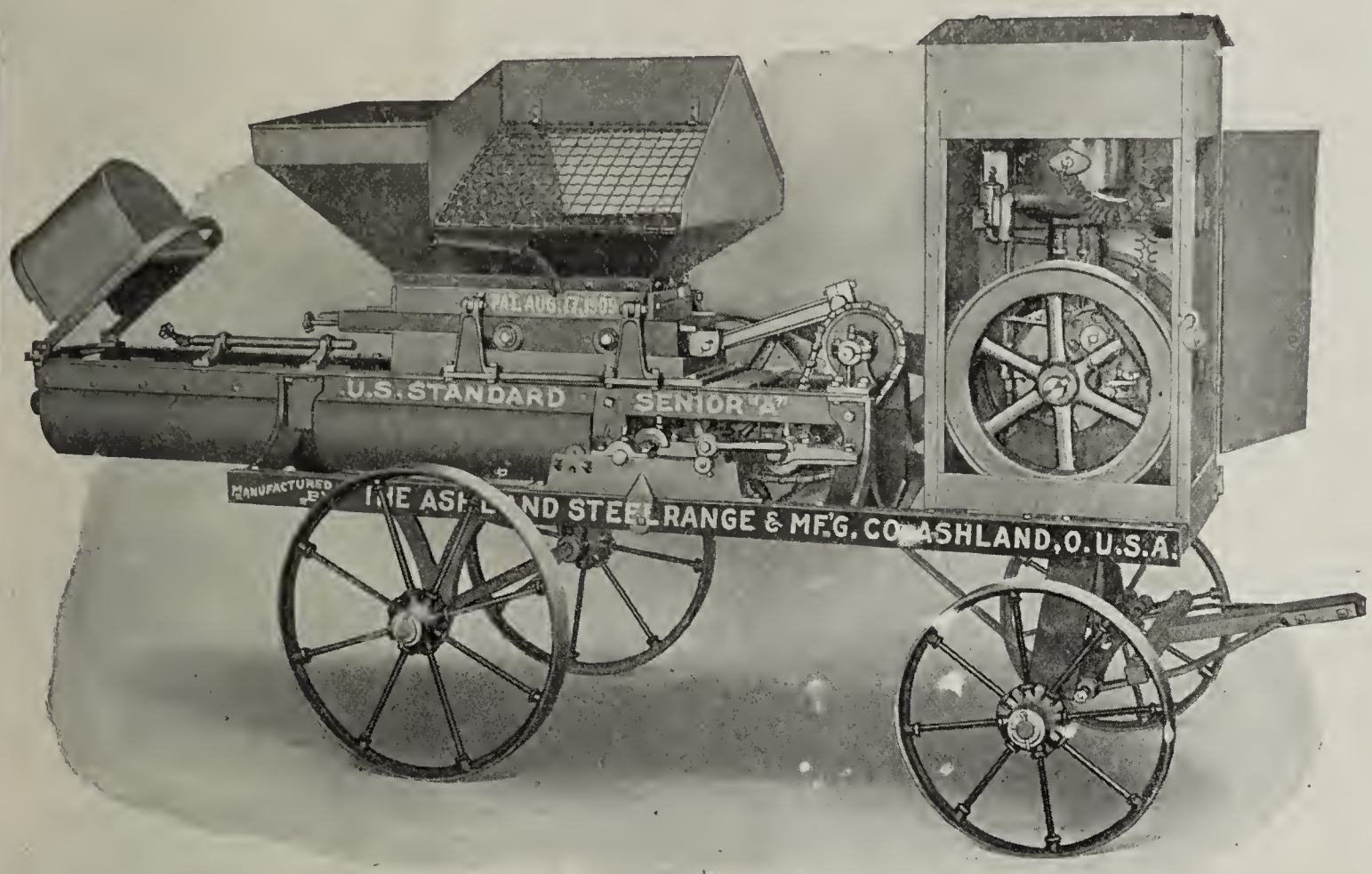

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Is Accurate in Proportioning the Materials.

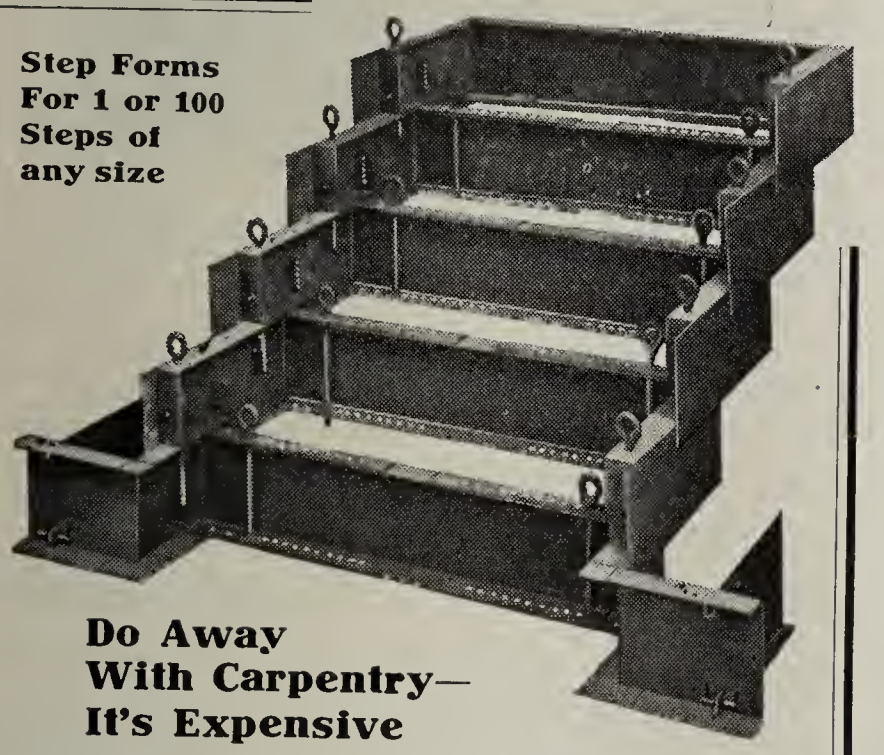
Mixes Dry Before Water Is Supplied Giving Thorough mixed, Uniform Product.

Capacity 7½ Yards Per Hour. Other Sizes in Stock at all Times.

Ask for Bulletin 21 and Mention Cement and Engineering News When Writing.

R. R. REED, General Sales Agent, ASHLAND, OHIO.

Step Forms For 1 or 100 Steps of any size



Do Away With Carpentry— It's Expensive

You can't afford to waste time on wooden forms if you expect to do your share of concrete step construction this season. No two sets of steps are alike in dimensions, and to build new forms for each job, it would require a big share of your time and profits. Before the season sets in, better look into the merits of the

Indiana Adjustable Step Molds

Adjustable to all sizes, enabling you to use the same forms on hundreds of different sized jobs. They are complete in themselves, not simply form holders, but a complete set of molds for molding concrete steps.

Circulars and prices on request.

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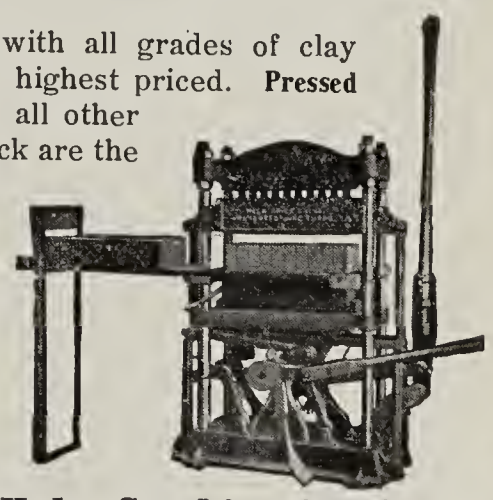
YOU Can Make BIG Profits IN PRESSED CEMENT BRICK

These brick compete with all grades of clay brick from cheapest to highest priced. **Pressed** brick are preferred to all other kinds. Helm Press brick are the easiest to sell because of superior quality — easiest and cheapest to lay because they are perfectly true and uniform. Every locality offers a market place for this product.



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Among The Cement Mills

SOLVING CEMENT DUST PROBLEM—A SUCCESS

After, an expenditure of $300,000 in experimenting, and the trying out of about thirty different systems designed to rid a cement plant of the fine dust that is so detrimental to growing fruit anywhere in the vicinity, the Riverside Portland Cement Company, Riverside, Cal., is confident that it has solved the problem effectually and for all time.

The system now in operation at the big Crestmore plant is the only one of its kind in the world. Every particle of the damaging dust is retained, and only the gases, rendered entirely harmless, escape into the atmosphere.

The ten huge treaters that comprise the dust-controlling apparatus, constitute a big plant in themselves. More than 1200 tons of structural steel enter into the construction of the device.

The gases are passed through an electric field, and before escaping, have been deprived of the vegetation-destroying elements. The amount of dust retained through this system of handling recompenses the company for the most of its operation.

NEW BOOK

The Aberthaw Construction Company has just published an attractive booklet on the Larkin Company's Warehouse and Freight Terminal at Buffalo, New York. This terminal with a floor space of over fourteen acres, is used for receiving, storing, packing and shipping merchandise brought from the company's various manufacturing buildings nearby.

The booklet describes the design and construction of this building, also the extensive conveyor system by means of which an order started on the top floor may be landed ready for shipment close to the freight cars, fifty-six of which may be accommodated at one time on the ground floor. Anyone interested in this unique structure may obtain the booklet from the Aberthaw Construction Company, 8 Beacon street, Boston, Mass.

ARIZONA CEMENT

The demand for cement is constantly increasing in Arizona. Concrete is extensively used for the construction of buildings and in the large irrigation works. The factory of the Arizona Portland Cement Company which is situated near Phoenix is now producing 250 barrels of cement daily. The plant has a capacity of 500 barrels and at the rate at which the demand for the output is increasing it is expected it will be running to this full amount in a short time. This is the only cement factory in Arizona.

ANOTHER ORDER FOR GRIFFIN MILLS

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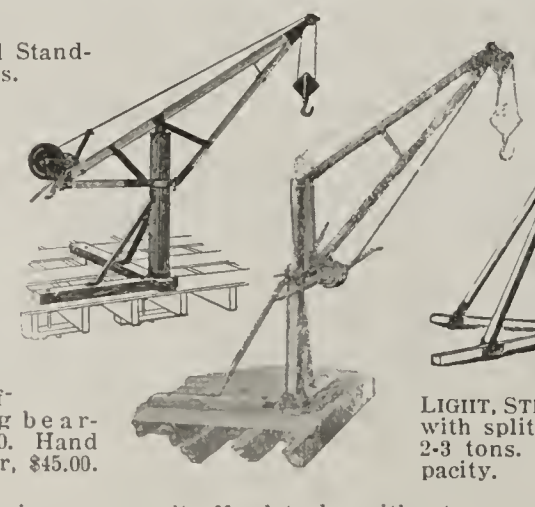

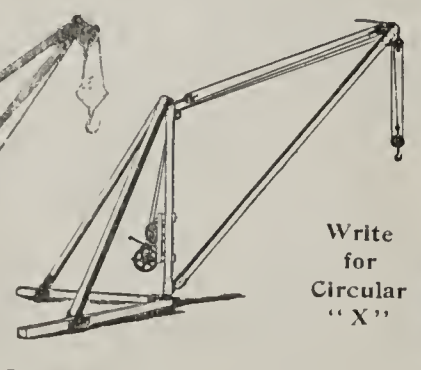

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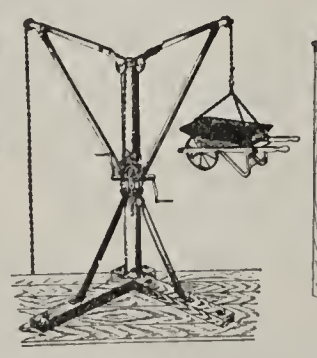

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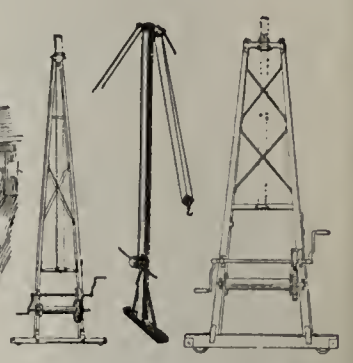

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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

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CHICAGO, NOVEMBER, 1913

ARTIFICIAL TRAVERTINE STONE FOR THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

One of the most interesting spots just now on the grounds of the Panama-Pacific International Exposition is the small structure, part studio and part laboratory, where the assistants of Jules Guerin, director of color, and Paul E. Danivelle, the originator of the imitation Travertine rock which will form the outer covering of the exhibit palaces, are experimenting with various tints and styles of this texture, not only for flat surfaces, but for columns, capitals, cornices and other details of architectural ornamentation.

The exterior appearance of the entire exposition will be one of great beauty from the color and texture standpoint. The Travertine rock or marble, is a peculiarly beautiful stone found near the banks of the Tiber River, in Italy, of which ancient Rome was built. The texture of the exposition palaces will be a correct replica of this rock, which is an agreeable substitute for the dazzling white plaster effects that have hitherto characterized the buildings of previous expositions. Instead of suggesting plaster and stucco, the entire exterior of the Panama-Pacific International Exposition will convey an impression of rare marble, soft in tone and color, and the stratified texture of its surface will give repose for the eye both by day and by night. It will have no distinct sharp color, but may be described as having several warm tones of grey and pink blended together, all an integral part of the mixture, which consists of sand, plaster and pigment.

The tone and horizontally stratified treatment will carry through all architectural forms and surfaces, including all sculpture. Here and there a note of contrast will be obtained by integral castings of columns in replica of Red Sienna or Numidian marble, or a verde antique bronze and gold, but even here the relation will be felt by this special stratified treatment. By this method life and interest will be given the vast wall surfaces.

In the courts, additional color will be used on the walls behind the colonnades, with here and there spots of color occurring in the architraves and cornices, as well as in the various domes, half-domes and niches. The whole impression gained will be one of great richness.

Roman Travertine was first artificially represented in the new Pennsylvania railroad station in New York City by Paul E. Danivelle, its originator and the supervisor of the present exposition plastic scheme. The composition consists of a specially prepared gypsum product, colored in accordance with formulae furnished by the exposition company and manufactured in such a way as to be adapted particularly for exterior use.

Where cast forms are not used, the plastic composition is applied directly to the grooved sheathing of the structures. All cornices, architectural columns and decorative ceilings are cast from moulds and secured to a skeleton frame of wood. All stucco on flat surfaces will be two-coat work, the first coat being a base coat of chosen mixture, without color, with sand and fibre, the second coat a colored mixture with a suitable portion of sand and finished with the desired texture.

The same effects will be carried out on all cornices and moulded surfaces, which will be cast from the ready colored mixture. The procedure in manufacturing is to prepare glue moulds in the usual manner. After the mould has been properly prepared, the first step is to lay on light and dark veins of liquid colored composition, which is done by means of specially constructed multiple veining cans. The second step is to lay on the semi-dry, or slightly damp, mixture, wherever the variegated indentations are desired. This mixture is just wet enough to take on a permanent set, and then a thin backing of the same mixture, but in a more liquid condition, is applied.

To make up the full thickness the mould is further backed up with uncolored mixture and reinforced in the usual manner with jute and fibre dipped in the liquid mixture, producing finally a cast varying from ¾ to 2 inches thick.

STATEMENT OF OWNERSHIP, ETC., FOR POSTAL AUTHORITIES.

Statement of the ownership, management, etc., of Cement & Engineering News, published monthly at Chicago, Ill., required by the Act of August 24th, 1912.

Note—This statement is to be made in duplicate, both copies to be delivered by the publisher to the postmaster, who will send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the Postoffice.

Publisher, Editor, and Managing Editor, William Seafert. Chicago, Ill.

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CEMENT & ENGINEERING NEWS is not incorporated; it is owned solely by William Seafert; residence, 435 S. Marshfield Ave., Chicago, Ill.

There are no bond holders, mortgagees, or other security holders, outstanding against Cement & Engineering News.

WM. SEAFERT.

Sworn to and subscribed before me this twenty-sixth day of September, 1913.

(Seal) ROBERT A. CLARA, Notary Public.

(My commission expires Aug. 17th, 1916.)

A Design For A Portland Cement Plant With A Car System For Transporting Materials

By C. J. Tomlinson, Bath, Pa.

A method of manufacture of Portland cement calculated to develop a logical evolution of economies in the work should be the object of every progressive plant manager. The extent and rapid growth of the industry has made it possible to expend considerable sums in the effort to accomplish economies; an economy of 1 cent per barrel or less than 2 per cent of the mill cost of manufacture, will pay 10 per cent on an investment of $182,000, in a 5,000-barrel plant. But if this work is not followed up in a logical manner the results fall far short of the possible economies that could otherwise be effected. The best interests of the industry are centered in this problem of cost reduction, and its solution. A cement plant manager contemplating the purchase of grinding machinery for rough grinding has, at the present time the choice of eight types of machines of radically different design that are being offered and installed for this work. The choice of crushers, of dryers, of fine grinders or of a type of kiln is simple in comparison; although the practice in these departments is far from standardized.

Each of these types of rough grinders referred to has a certain economic adjustment, speed of driving rate of feed, degree or fineness of the material being fed and fineness of production. Then, too, the nature of the materials being treated varies in the different localities.

These machines are designed under the most empirical rules as to proportions and economic size, and are usually installed over a mill conveyor alongside a number of other grinders, given a short test as to rate and fineness of production and then thrown out or enthusiastically adopted. In the latter event, the continuous duty required of them develops a thorough understanding of their peculiar objections—the store room repair charges for some part are considered excessive—and the search is resumed.

In order to successfully evolve an ideal design or type of machine for this work, it is necessary to secure complete data of the performances of the various modifications leading up to this result. It is not enough to know that a machine will do the work; it is of the highest importance to know by just what amount a change in design or operation affects the economic result.

The obvious method to accomplish this is to weigh all of the production of the different machines and to test it periodically as to fineness; in fact, create an immense testing department of the grinding departments in which the different modifications are tested to destruction under the most searching and equal competition.

In order to do this, it is necessary to install a conveying equipment that will make it possible to give the different machines individual attention. In an effort to solve some of these requirements, I have prepared the accompanying tentative plans of such a plant. The various types of continuous conveyors and elevators are not readily adaptable to these requirements and are also a source of considerable annoyance in the operation of a large plant, and in these plans have been replaced with an arrangement of electrically-operated scale and larry cars and skip hoists. The elevating is concentrated in four double-track skip hoists with skips of 12 tons capacity each. These hoists are so situated as to form an alternative path for the movement of material in case of breakdown of any one of them.

The plans represent a plant with a capacity of about 5,000 barrels per day and show also space for future increase in the different departments.

The rock is first dumped from the quarry car into one of the skips at hoist No. 1 and elevated to the bin above a 67-foot level track, over which it is trans-

FIG. 1. GENERAL PLAN OF PORTLAND CEMENT PLANT

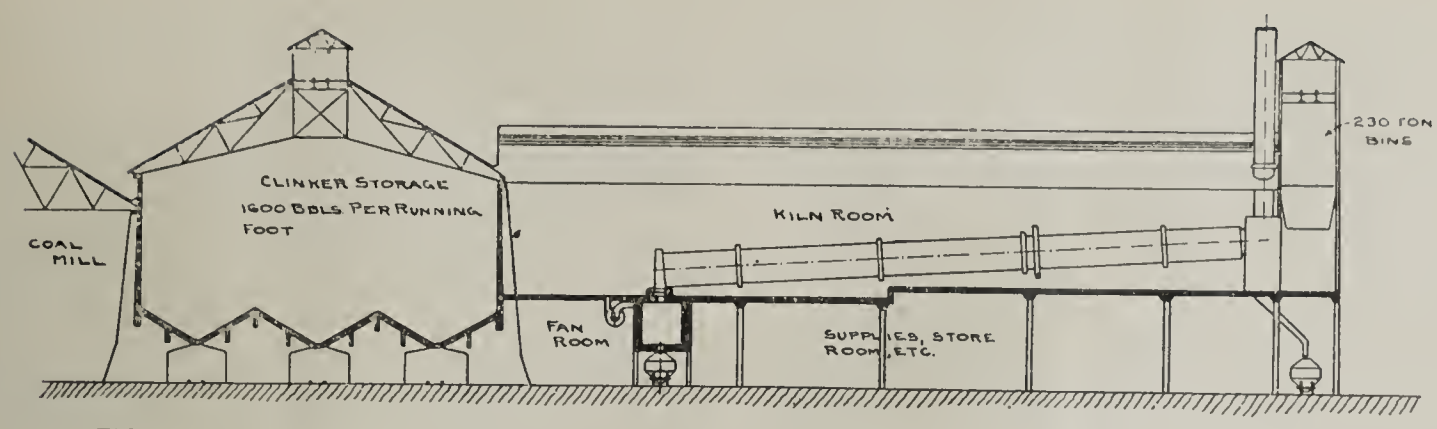


FIG. 2. LONGITUDINAL SECTION THROUGH KILN ROOM AND CLINKER STORAGE.

ported to the crushers in the crusher and dryer building by a motor-driven hopper-bottom car. The elevation of this track is enough to provide a gravity path for the material through screens, crushers, dryers and rolls, from which it falls into bins over the regular narrow gage yard tracks. The cars operating on these yard tracks are similar to those in use in the storage yards of blast furnace plants and consist of two short bogies with railway type motor and having a heavy hopper-bottom car body hung on suitable scales.

The material is taken from the dryer house back to hoist No. 1, elevated and transferred to the raw mill directly, or to the rock-storage bins beyond the dryer and crusher building. In case the material is taken to storage-bins, it is subsequently transferred by the scale car to hoist No. 1 and thence to the raw mill. The scale car then moves on beneath the raw mill to receive the ground material, which it transfers to hoist No. 2. This hoist is similar to No. 1, with the addition of suitable dampers or doors to confine the dust, and delivers the powdered material to the car operating over the kiln room bins and raw grinding department.

The plan of the yards and the elevations shown should make this readily understood, and as the system of handling the clinker and cement is very similar to that for the raw material, it will not need further explanation. The clinker may be taken from the kiln bins and readily handled at a much higher temperature than is practical with continuous conveying machinery. The clinker storage yard for aging the clinker will require the services of a special machine, a pair of heavy motor-driven rolls mounted complete with two swinging booms carrying short belt conveyors. This outfit should be mounted on two narrow-gage bogies so that it may be readily moved from place to place under the yard or the machine shop. The wear on these roll shells is very rapid and the shop crane will expedite the repairing required. A spare outfit of this sort would be found useful in replacing the services of a pair of rolls, undergoing repairs, in the rock-dryer department.

The plans show no dryer department for drying the clinker taken from the storage yard. If there are good and sufficient reasons for saturating this clinker, as is done in some plants, a dryer department should be introduced between hoist No. 3 and the finishing mill.

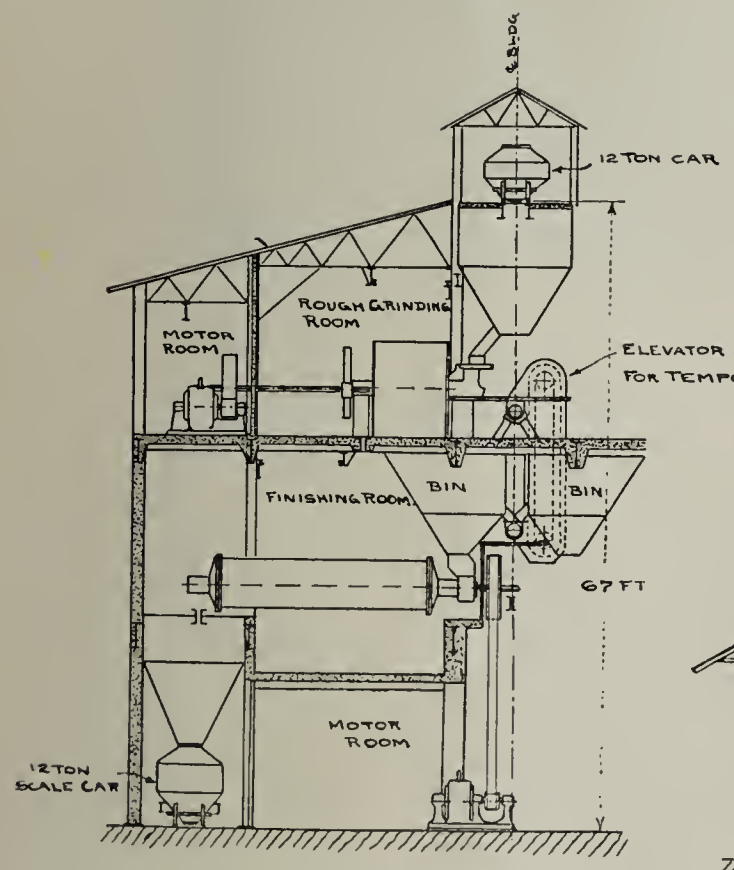


Fig. 3. Half Cross-Section of a Grinding Department.

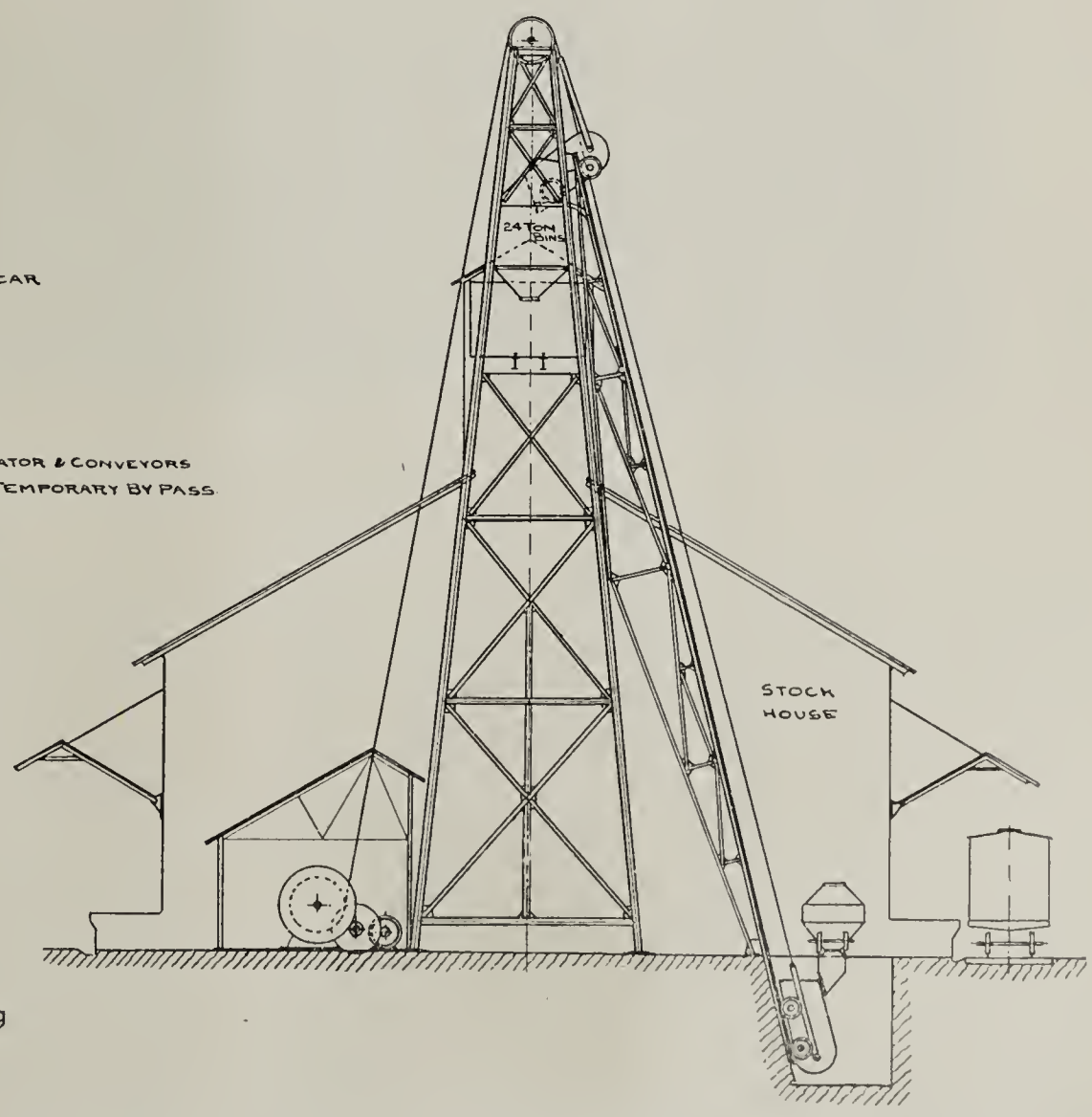


FIG. 4 ELEVATION OF 12-TON HOIST BETWEEN FINISHING MILL AND STOCK HOUSE

It should be practicable to serve the entire plant, on occasion, with four motormen, one operating a car on each of the elevated tracks and one on each of two cars in the yard systems. The hoists may be started from the scale car platforms and will automatically stop themselves, as is the practice at a number of blast furnace plants.

In these plans no concessions have been made in an effort to economize the first cost of erection, nor are they intended to do more than clearly show the application of the conveying equipment. In regard to the question as to whether departments of this arrangement will give as good results in maintaining or perfecting the proper mix on the raw side, it should be noted that the storage department here shown, in connection with the scale cars, offers a system that should be of considerable value in producing the required mixture; and the operation of dumping into hoists, then to bins, then to cars again, then to bins over machines, should mix the charge as completely as is ever accomplished by the use of a common conveyor in a commercial plant. And then the powdered material is given this working again in the process of delivering it to the kilns.

The intimate admixture of the materials accomlished by the average conveyor system is of meager value in comparison to that produced in the average fine grinder.

In conclusion, these plans show a radical departure from accepted designs for this work, but as the plants have increased in size, it has become more and more evident that the problem of efficiently serving the machines could only be met by a most radical solution The serving machinery should combine efficiency and flexibility, be a ready means of information regarding the machines it serves and, finally, be of the greatest aid and least interference in the difficult tasks of repairing these machines.

CRACKS IN CONCRETE

Their Causes as Shown by Experience, with Practical Suggestions for Their Prevention

(Abstract of a Report Submitted to the British Concrete Institute)

Cracks in concrete are unsightly but not necessarily dangerous. They may be classified under two heads: Surface Cracks and Body Cracks.

Surface Cracks—These are often referred to as "hair cracks" by reason of their fineness and semblance to hairs, and occur in both plain and reinforced concrete. They are also known as "crazing," and are of very frequent occurrence. They appear to arise from the surface skin of cement mortar being richer in cement than the mortar of the body concrete, thus exposing almost a neat cement skin, which expands, on exposure to the sun's rays, at a dfferent rate from that of the body concrete. This is worse upon the uppermost face in a mold, where the lighter and weaker particles of cement work up to the top and form a skin known as "laitance." If work be kept under water, and sometimes if shielded from the sun, this crazing may not occur. To overcome its unsightliness, the surface skin should be removed either (1) by brushing the concrete, when green, with wire brushes; (2) by rubbing with a stone or piece of concrete and sand and water; (3) by dressing with hand-operated or pneumatic chisels and hammers; or (4) by brushing the surface with hydrochloic acid, and subsequent washing with clean water. The last two named methods are best with completely hardened concrete.

Body Cracks—Cracks extending through the body of concrete may be ascribed to the following:

1. Faulty design and construction so far as statical resistance is concerned.
2. Expansion of cement or concrete.
3. Corrosion of embedded steel.
4. Shrinkage from setting and hardening in air.
5. Difference of temperature in different parts.

Faulty Design or Construction

Under this head the following causes have been noted:

(A) Settlement of the foundations.

(B) Too high a stress in the reinforcement, resulting in excessive deformation.

(C) Too thick a covering of concrete, in particular where the effective depth of beams is very small.

(D) Too early removal of forms. The age of the concrete when the forms are removed must be sufficient to give the usual factor of safety due to the stresses caused by dead load and such accidental load as may at that time be anticipated. Generally the following recommendations are made, subject to the approval of the engineer or architect responsible for the work.

For mass concrete walls not subject to thrust, and where the height does not exceed 2 feet, the forms should not be removed under 24 hours. Where the wall is subject to pressure, forms should remain in place at least a week, although a fortnight is preferable. For mass concrete arches of more than 20 feet span, one month is recommended.

For reinforced concrete the following practice is recommended: Slabs, a minimum of seven days; but other wise, for slabs carrying only their own weight, an allowance of two days per inch of thickness, or one per foot of span, whichever is the greater. For sides, of beams, walls, and columns not under side thrust, a minimum of four days; bottoms of beams, a minimum of two weeks, though a month to six weeks may be necessary under special circumstances. For arches, the time of removal of the centering is better left to the judgment of the engineer, keeping in view the ratio of rise to span and special circumstances.

If it is intended that the structure shall be used for carrying heavy weights, emergency props should be left in for such time as the engineer or architect may direct.

The foregoing periods to be increased by at least the time during which frost or rain has intervened.

(E) Defective design of forms with inadequate allowance for contraction and expansion due to variation of moisture. Dry timber may expand and crack the concrete unless wetted beforehand.

(F) Careless removal of forms, which may result in cracking the concrete by shock of falling timber, or by levering and pressing on the green concrete.

(G) Vibration, resulting in deficient adhesion and excessive deflection. Form should be very rigid.

(H) Insufficient allowance for continuity, fixity, and general monolithic nature of concrete work done in situ. Over supports, the maximum degree of continuity and fixity should be provided for. Frequently cracks will be found over supports of continuous reinforced concrete beams and floor-slabs, owing to the omission or insufficiency of steel there. Concrete floors are often built in chases in walls and carried over walls, others standing above; and sufficient fixity is given to cause cracks, if provision has not been made in the reinforcing. Columns and piers, when built monolithic with beams, will give more or less fixity to end of beams resting thereon, both at end and intermediate supports.

(I) Too close spacing of steel, so that there is no room for the concrete to get round and adhere or bond with the bars.

Expansion of Cement or Concrete

Under this head the following causes of cracking are noted:

(A) Over-lined and coarsely ground cements, which were frequently met with years ago, caused expansion, to overcome which it was necessary to leave room for expansion—i. e., expansion joints. Especially was this precaution adopted around the edges of floor-slabs adjoining walls.

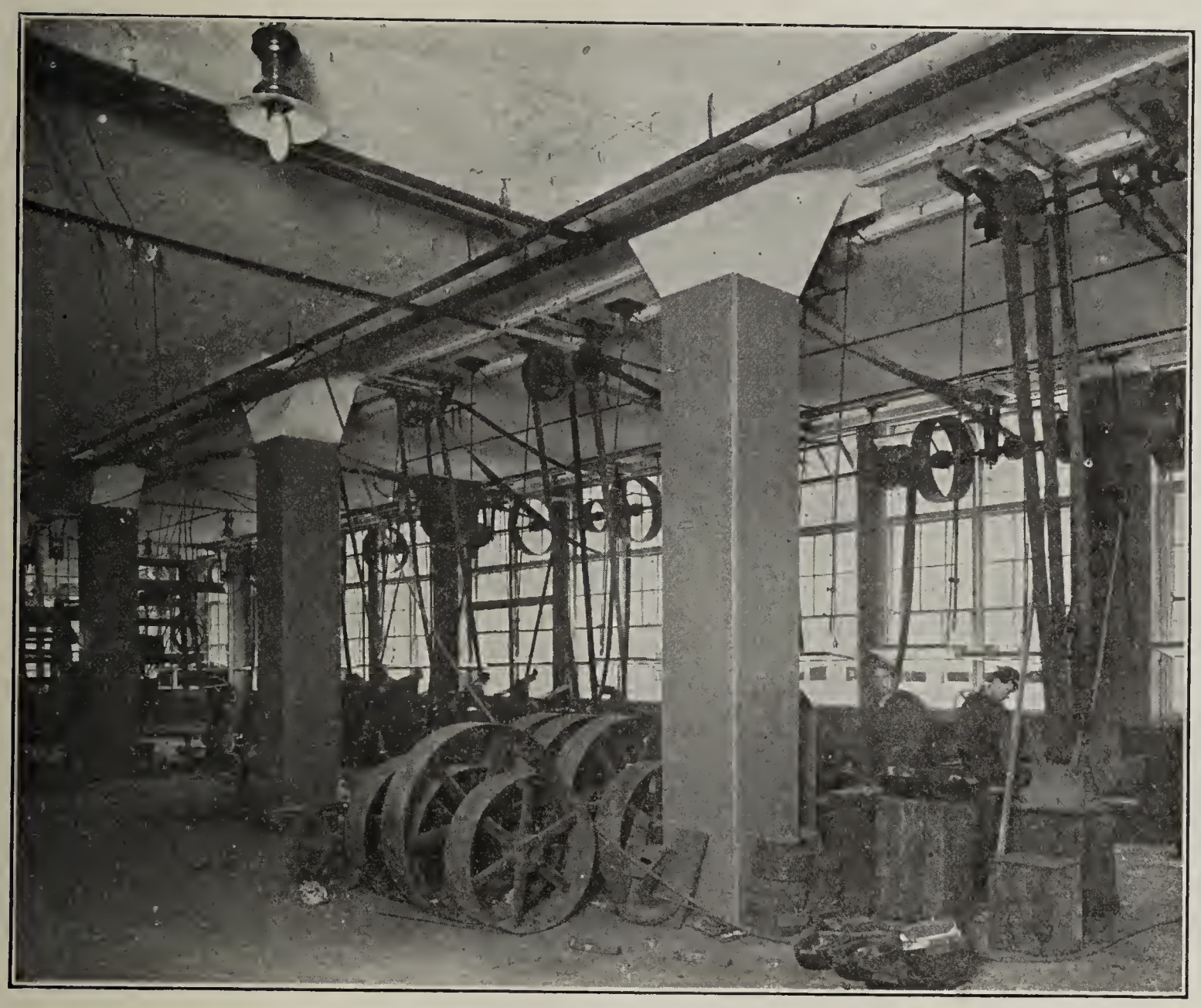
(B) Coarse materials containing sulphur compounds, unburned fuel, oxidizable or hydratable iron compounds, unslaked lime, and other deleterious substances. Breeze, clinker, and slag frequently contain sulphur and metallic iron or oxide of iron, while boiler ashes may contain both sulphur and unslaked lime

Corrosion of Embedded Steel

Should the steel in reinforced concrete corrode by reason of porosity of the concrete or the presence of deleterious substances in the coarse materials of which it is made, or by electrolytic action, the concrete cover to the bars will crack and burst off.

Shrinkage from Setting and Hardening in Air

This is probably the most frequent cause of cracking. Concrete will expand slightly in water, and contract on drying out, so that cracking is frequently not evidenced from this cause until the concrete is allowed to dry, which requires a period varying usually up to two months; and in thick mass walls, moisture and heat are retained for a long period, and may delay cracking up to six months and even longer. It is



Interior of the New Reinforced Concrete Truck Assembly Building of the Pierce Arrow Motor Car Co., at Buffalo, N. Y.
This Building is Designed with Girderless or Mushroom Type of Reinforced Concrete.

(the latter derived from limestone in the coal). Some bricks contain sulphides and sulphates and lime, and should not be used broken for concrete. Old bricks also sometimes have old plaster adhering to them; the sulphate of lime may cause no trouble in plain concrete while it is kept dry, but, in the presence of water, reacts chemically with the aluminates of the Portland cement, forming sulphoaluminate of lime, which is attended by increase in volume, and may cause blowing if in large quantity, and even a small quantity may result in cracking. Free lime in the same way will swell or contract with water. Black magnetic oxide of iron will become converted into hydroxide of iron in the presence of moisture. Indeed, any iron compounds are dangerous in reinforced concrete as likely to react electrolytically with the steel in the presence of moist air or dampness; and sulphur causes speedy corrosion.

usual to keep concrete wet for several days after manufacture, in order to ensure it gaining maximum hardness; and it is specially important to prevent rapid drying by sun and wind, so that the surface of concrete should be shielded against such exposure. A dry mixture of concrete shrinks less than a wet mixture, and concretes richer in cement contract more than lean mixtures. For reinforced concrete work, medium wet mixtures are desirable, and therefore concrete richer in cement than 1 to 5 is not advisable for curtain walls. The coefficient of contraction of concrete on exposure to air appears to be about 0.0002 to 0.0005 at one month, and increases to about 0.0004 to 0.0006 at 1½ years. The variation recorded is between poor and rich concretes. Such contraction is usually prevented from taking place uniformly throughout; in retaining walls and pavings, it is prevented by friction of the soil; in other cases, by the

holding of other parts. Plain concrete will usually hold together for some distance, so that contraction joints need be inserted only at intervals. The following are advised as suitable distances apart of such joints in plain concrete: Paving 4 to 5 feet; curtain walls, 10 feet; exposed retaining walls, 15 to 20 feet; basement retaining walls (not exposed) and dock walls or dams, 50 feet.

If curtain walls adjoin heavy columns and beams the rigidity of the latter would probably result in cracking if constructed monolithically, even if reinforced. It is best, therefore, in such cases, to provide joints adjoining beams and columns.

REINFORCED CONCRETE FENCE IN THE UNION STOCK YARDS, CHICAGO, ILL.

If concrete be laid over the joints of a thicker lower surface of concrete, the joints of the latter will most probably be evidenced in the upper surface.

Large surfaces have been successfully constructed without apparent cracks, by properly reinforcing the concrete and laying all at one operation. The object of the reinforcement is to break down the tensile resistance of the concrete, and cause it to crack uniformly at such close distances as to render the cracks invisible to the eye. If one portion of the concrete be left over-night, great care should be taken to roughen the hardened surface by tooling away; then clean by brushing with water, and apply half an inch of mortar of the same proportion as the mortar in the concrete, and ram the fresh concrete well against it. Such joints will often show, even though well reinforced. In calculating the amount of reinforcement for such purpose, the ultimate tensile strength of the concrete at one month should be equated to the resistance of the steel at the yield-point. Usually, for a 1:2:4 concrete, ½ per cent of steel is required each way, the bars or meshwork being laid at right angles. The reinforcement should be in small sections and well disseminated through the thickness of concrete, and a layer of bars should be near each face. So-called "distribution bars" near the bottom of floor-slabs are not sufficient if cracking is to be resisted; rods should also be placed near the upper surface. Cracks frequently occur parallel to rods where "distribution bars" are not used, and also occur at right angles to main bars where continuity bars stop; top reinforcement would avoid this. Contraction reinforcement should be in addition to the section of steel required to resist static forces.

The sudden drying-out when heating apparatus is installed, frequently causes excessive cracking.

Difference of Temperature in Different Parts

Considerable difference of temperature will cause cracking, and should be avoided as much as possible. Heavy reinforcement is not always an effective preventive. Most reinforced concrete chimneys in which the internal temperature is over 500 degrees F. seem to be cracked vertically, externally, and often horizontally as well, though possibly the latter could be avoided. This cracking is probably due to the difference in temperature between the outside and the inside, which may be considerable with a cold wind blowing. A continuous lining, with cavity between it and the outer shell, would probably prevent serious cracking.

Reinforced Concrete Paving at Port Huron, Mich.

Contributed by Earle R. Whitmore, City Engineer, Port Huron, Mich.

The first concrete pavement in Port Huron was laid during the months of September, October and November, 1912. It is therefore much too early for us to proclaim our method either a success or a failure. But certain advantages and disadvantages of this type of paving and of our method of building it have already been demonstrated, partly on account of the peculiar conditions under which this particular job was done.

The pavement was laid on Griswold Street from Sixteenth Street to Twenty-fourth Street, a distance of one-half mile, and was made 36 feet wide with double track street car line in the center as indicated by the accompanying cross section, except on two blocks which have single track only. This is an outlying street, leading, however, to a main traveled road into the country, and also to the Grand Trunk Ry. depot, and the traffic, while not heavy, is considerable.

Bids were received at the same time for concrete and bituminous macadam. This gave us better competition than would have been secured by receiving bids on only one material, and the bidding was close. The lowest bid for reinforced concrete, and the one on which contract was awarded, was $1.22 per square yard, and the next lowest $1.42 per square yard. Low bids for bituminous macadam were $1.18 per square yard for 5-inch slag macadam base and 2-inch bituminous macadam top of crushed cobble stones, Barber Asphalt Company's standard specifications for asphalt macadam, mixing method; $1.24 per square yard for bituminous macadam same as above with limestone macadam base instead of slag; and $1.34 per square yard for 2-inch asphaltic concrete of crushed cobbles on 5-inch limestone macadam foundation.

It will be seen that the difference in first cost between bituminous macadam and reinforced concrete was not sufficient to influence choice materially. The matter "hung fire" for some time, and I prepared for the use of the City Commission and interested property owners the following study of the comparative merits of the two types of paving. This comparison was based upon what I had seen of both types of paving in other places, as at that time neither had been tried in Port Huron.

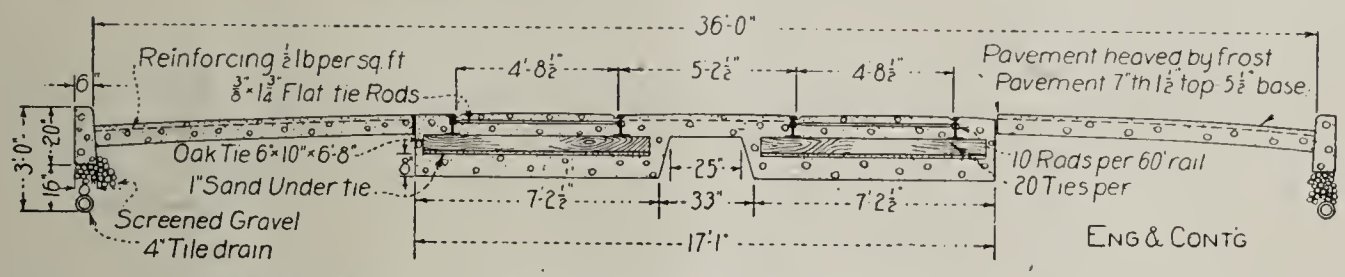


Fig. 1. Transverse Section of Reinforced Concrete Pavement at Port Huron, Mich.

Description

The asphalt macadam, as proposed, consists of a 5-inch foundation of slag macadam with a wearing surface of 2 inches of crushed fieldstone mechanically mixed with asphalt and spread and rolled while hot; a sealing coat of hot asphalt spread over the surface afterward, and stone chips rolled into the surface to take up the surplus asphalt and give a finished appearance. The finished pavement resembles sheet asphalt in appearance, with a slightly rougher surface.

The proposed concrete paving consists of 5½-inch gravel concrete base, 1 part cement to 5 parts gravel, reinforced with ½ pound of iron to each square foot; 1½-inch wearing surface, 1 part cement to 1½ parts suitable sand and 1½ parts fieldstone chips ½ to ¾-inch size; expansion joints protected with steel every 16 feet across the pavement and along the pavement each side of railway tracks; and 4-inch vitrified tile drain under each edge of pavement.

Economy

(a) First Cost—The difference in first cost is too small to have any weight.

(b) Maintenance—It is my personal opinion that a properly constructed reinforced concrete pavement such as we have specified will be considerably more economical in maintenance than the asphalt macadam. Both are giving good service and are being widely used, and of course both have their failures. The concrete will not deteriorate with age, and is not injured by water, street acids, oil or leaking gas, all of which are more or less detrimental to asphalt. It is claimed by the adherents of the asphalt paving that the concrete grinds out under traffic to a greater extent than the asphalt; but experience has shown that where properly laid it wears very slowly, especially on streets with comparatively moderate traffic, such as Griswold Street. As long as the asphalt maintains its original grade the water from rains, etc., runs off too quickly to cause any perceptible damage; but when the surface becomes sufficiently uneven to hold pockets of water, or if the surface is made with poorly graded stone, leaving crevices to catch the water, the moisture will damage it seriously. For this reason, and because it is hard to make a smooth, uniform gutter of macadam, it is considered better practice to use combined curb and gutter of concrete with asphalt macadam paving.

The asphalt is more easily torn up for putting in gas or other service pipes, having some advantages over the concrete in this respect. Both are easily repaired, but the asphalt patch may be opened to traffic immediately, while the concrete must have several days to set.

The quality of the asphalt pavement may be seriously affected by improper judgment in selecting a grade of asphalt suitable for the climate, or by lack of skill or improper appliances for putting it in, and to some extent by the condition of the weather at the time it is laid, which should be dry and warm; while concrete is less subject to damage from these causes.

(c) Ease of Traction—The resistance to traction would be practically the same when the pavements are new. The one which will maintain its uniformity

of surface the longest has the advantage in this respect, and I would therefore be inclined to favor concrete on this score.

(d) Good Foothold for Horses.—With the surface made in accordance with our specifications I think there would be little difference as to slipperiness. The concrete would perhaps give a slightly more secure footing. Both forms of paving are fairly good in this respect, and as there are no heavy grades on the street there should be no trouble along this line. It is claimed for asphalt that it is easier on horses on account of greater elasticity. There may be some slight merit in this claim, but except in very warm weather the asphalt is not sufficiently soft to make much difference.

(e) Ease of Cleaning.—I would give concrete a little the best of it on this, though the asphalt is easily cleaned, especially when new.

Sanitary

(a) Noiselessness.—Both are very good in this respect, with possibly a slight advantage in favor of the asphalt when new.

(b) Healthfulness.—Both excellent.

Acceptability

(a) Freedom from dust and mud—Both good.

(b) Non-reflection of heat—Both fair.

(c) Appearance—Both excellent. Asphalt has slight advantage when new.

We might summarize as follows:

Economic

Qualities.	Percentage assigned to quality. Ideal	Asphalt macadam.	Concrete.
Low at first cost.....	15	10	10
Low cost of maintenance..	20	12	15
Ease of traction.....	10	10	10
Good foothold	5	3	3
Ease of cleaning.....	7	6	7
Easy to tear up and replace	3	2	1
Total	60	43	46

Sanitary

Noiselessness	15	10	10
Healthfulness	10	10	10
Total	25	20	20

General Acceptability

Freedom from mud and dust	8	6	6
Non-reflection of heat.....	3	2	1
Appearance	4	3	2
Total	15	11	9
Grand total	100	74	75

It will be seen from the table that concrete was considered preferable from the standpoint of economy; both equal (and good) from a sanitary standpoint; and that in the matter of non-reflection of heat and of appearance (when new) the asphalt macadam was believed to have a slight advantage. Of course the table would look quite different if prepared by an enthusiastic adherent of either class of paving. I tried to judge impartially, being entirely unprejudiced, and believing that the city would get good value for the money expended in either case. It was not anticipated that either class of paving would be as durable as a first class brick pavement, for instance; but the brick pavement would cost about 60 per cent more, and our experience has shown, as I will point out later on in this article, that the reinforced concrete pavement as we built it has some advantages over even a good brick pavement as ordinarily built. The grand total values of 74 and 75 per cent which I assigned in the table were not intended to represent only that per centage of value as compared with any ordinary first class paving, but as compared with an **ideal** pavement. The ideal pavement, like most other things ideal, does not exist in reality.

The foregoing comparative study was prepared just one year ago. Contract was awarded for reinforced concrete on this street and for asphalt macadam on two others. The season was a very wet one, which was, of course, a greater disadvantage to the asphalt macadam construction than to the concrete. Partly on this account and partly for other reasons we had greater success with the concrete construction than with the asphalt macadam, and if I were preparing a comparative study of the two forms of paving at the present time I would be inclined to give still greater advantage to the concrete for durability and ease of cleaning and less advantage to asphalt macadam in non-reflection of heat and appearance. It might appear that some advantage should be given to the bituminous pavement as being easier to repair when worn down normally, but our experience is that such repairs are not so easily made in a satisfactory manner as might be supposed. Concrete paving has been slow in gaining recognition as compared with bituminous paving, but it is to be borne in mind that the various forms of bituminous paving are being constantly and vigorously promoted by corporations interested in the sale of asphalt and tar products and by patentees of certain bituminous pavements, whereas the concrete pavement has no press agent—or at least this has been the case until recently. Some of the larger cement companies are now beginning to advertise the advantages of the concrete pavement. When constructed under ideal conditions, with proper equipment, the materials just right, the best workmanship and favorable weather, the bituminous pavement no doubt has some advantages over the concrete; but as ordinarily constructed and with the inspection and workmanship usually available for such work these advantages mostly disappear.

This concrete pavement replaced a worn out plain macadam pavement which had been built upon the old roadbed without curb and was over a foot above the sidewalk grade in places, so that the excavation for the new pavement was considerable. The haul was short, however, most of the excavated material being disposed of on low lots with a lead of 75 to 300 feet. There was a single track street car line in the center of the old pavement, and the first step toward the construction of the new work was to build a temporary track on the south side of the old pavement and tear out the old track. This was done without delay to traffic, and the excavation for sub-base for new tracks and for paving on north side of street and laying side drains and constructing concrete curb were carried on simultaneously.

The franchise of the electric railway company does not require them to pay any part of the expense of paving, and the contract price of $1.22 per square yard was for 7-inch pavement clear across street, including that between rails; but all excavation and concrete below this 7 inches was paid for by the electric railway company. All track work was done by the electric railway company's men, but excavation and concrete base for track was done by the paving contractor under arrangement with the railway company.

This concrete base was the first concrete poured, and as soon as this was in the railway company placed tracks on it. Pavement was then laid on the north side of the street and across the tracks to the expansion joint south of the south rail. As soon as this was hard enough to be safe the street car traffic was diverted from the temporary track to the permanent track, and the temporary track removed and excavation completed and pavement laid on the south side of the street. This arrangement made it necessary to move the concrete plant the entire length of the street three times; first, for base for tracks; second, for paving the north side and tracks; and third, for paving the south side. The work was done in this way without interruption of street car traffic.

The rails of the permanent track were to be "welded"—a casting poured around the joint in place of the ordinary bolted joint, with thin steel shims driven between ends of rails and filed off flush, making a practically continuous rail; but the machinery for doing this was not available at the time the paving was laid across the tracks, so it became necessary to box off each rail joint (60 feet rails were used), leaving an opening in the pavement about 7 feet square at each joint. These large openings were necessary to admit the heavy clamps used in the welding process. The pavement was nearly completed in all other respects before the machinery for welding the rail joints arrived, and these openings collected water during wet weather, which soaked from them into the sub-grade; so that the sub-grade was undoubtedly quite saturated when cold weather came on. The easterly portion of the street has sand subgrade, affording good natural drainage, and the saturation of sub-grade did no damage here; but the westerly portion is heavy clay soil, and this, being saturated with water, "heaved" when frozen so that the edges of the paving on the outside of the expansion joint on each side of the car track were from ½ inch to 2 inches above the paving next car track, as shown by accompanying section. This did not crack the pavement, however, and when the frost left the ground **the pavement went back to normal grade undamaged.** The pavement across the car tracks was undisturbed by the frost, probably because the concrete extended so deep that there would not be much frost below it.

I do not think that any other form of paving, as ordinarily constructed, could have withstood this heaving without serious damage. Of course the concrete pavement was only saved by the expansion joints next the tracks, and this joint is not provided in other forms of paving.

I have used the term "expansion joint" in conformity to custom, but in concrete paving at least these joints serve other purposes fully as important as that of providing for expansion. If expansion only were to be provided for, a single joint next the curb with transverse joints every 100 feet or so would be ample. But experience has shown that a concrete pavement cannot be built in such large blocks without cracking. Sometimes this cracking is due to settlement of subgrade, poorly filled trenches, internal stresses developed in the setting of the cement, or by expansion; but more often than all these put together it is caused by frost. With sand subgrade the frost danger is slight, but on heavy clay subgrade it cannot be given too much importance, and I would not attempt to build a concrete pavement on such subgrade, even with good side drains below the curb, without a longitudinal "expansion joint" along the crown. Dry clay will not heave with frost, but it is almost impossible to construct side drains so that they will be sure to keep the subgrade dry under all conditions. The danger of damage to pavements by frost has been given altogether too little emphasis, while the danger from expansion has been unduly advertised. The writer has given considerable study to failures of this character in rigid pavements, and his observations have convinced him beyond doubt that the longitudinal cracks which so often develop along the crown (or sometimes several feet to one side of the crown) in pavements of this class are nearly always, if not always, caused by frost—that is, freezing of subsoil—though usually ascribed to expansion. Careful observation will discover the fact that these cracks invariably first appear in the form of a very small and insignificant appearing crack when the snow goes off in the spring; that where the subsoil is clay the cracks develop (unless there is exceptionally efficient drainage) in pavements provided with ample expansion joints; that where the subsoil is sand, or on fills where there is good natural drainage, the cracks do not appear, even when no expansion joints whatever are provided; and that the crack usually follows along the line of the street, where the snow is packed by traffic during the winter and the frost penetrates deepest. Also, in the case of brick pavements, the concrete foundation is found to be cracked immediately below the crack in the surface—a condition not likely to be brought about by expansion.

The writer's apology for having brought into this article a discussion of the dangers to be apprehended from freezing of subsoil is that so few specifications even mention this most important source of danger to rigid pavements, or make provision for any expansion joints except such as are presumed to be required to allow for expansion or contraction in the pavement itself, caused by heat and cold.

The following is a brief outline of our specifications for concrete pavement:

(1) Preparation of Subgrade.—Usual specification. Subgrade to be kept moist by sprinkling ahead of the concrete.

(2) Sub-drainage.—4-inch vitrified clay sewer pipe, bell and spigot, laid 3 feet, below top of curb, joints left open, connected with lateral sewer, covered with coarse screened gravel to bottom of curb as shown in cross-section.

(3) Curb.—Concrete, one mix, wet, proportions, 1 part cement to 4 parts gravel as specified below.

(4) Cement.—Specifications of American Society for Testing Materials. One bag of cement (94 lbs.) to be considered to have a volume of 1 cubic foot in proportioning concrete.

(5) Gravel.—Maximum size 2 inches, selected river washed gravel containing sufficient sand to fill voids and not more than 50 per cent by measure passing No. 4 screen.

(6) Concrete.—First course, 5½ inches thick, 1 part cement to 5 parts gravel, specified above.

(7) Concrete, Top Course.—1½ inches thick, 1 part cement, 1½ parts selected coarse, sharp sand and 1½ parts trap rock or crushed cobbles ½ to ¾ inch size, containing no dust.

(8) Depositing and Finishing.—Top to be placed immediately after depositing base. Not more than 40 minutes to elapse from time base is mixed until top is floated. Top to be stroked off with a template and rough troweled. No "glass finish."

(9) Expansion Joints.—To extend entirely through pavement, leaving an opening not more than 3/16 inch nor less than ⅛ inch in width. Edges of expansion joints protected by steel plates anchored to concrete and joints filled with asphalt paving cement. Longitudinal expansion joint on each side of railway tracks about 18 inches from the rail and transverse expansion joints from curb to curb every 16 feet.

(10) Street Car Tracks.—Contractor to be paid for paving across tracks the same as though they were not there, and electric railway company required to make their own roadbed or arrange with contractor to have same done.

(11) Protection.—Surface covered with 1 inch of fine sand as soon as set sufficiently and sand kept moist by sprinkling during first three days.

(12) Reinforcement.—Approved reinforcing of expanded metal or wire fabric weighing not less than ½ pound per square foot, to be placed between base and top course.

(13) Opening to Traffic.—Not opened to traffic for at least 10 days after laying.

It will be noted that the curb is unusual in that it is all one mix, poured wet. We have used this construction for curb during the seasons of 1911 and 1912, with uniformly good results. The face board must be planed smooth, and should be oiled; and the concrete must be well spaded next face. The cost is about the same as where built in the ordinary way with mortar face, mixed dry. The finish is not quite so neat, but is free from hair cracking and other defects common to the dry process, and makes a stronger and harder curb.

The hard stone was used in the wearing surface to take the wear of traffic, and it was also anticipated that the stone chips would make a surface which would be less slippery than where all fine aggregate is used. The result seems to be very good. Heavy traction engines have passed over the street without leaving a mark, and the surface is much less slippery than sheet asphalt, and is at least as good in this respect as brick. We consider it a serious mistake to block off a concrete paving surface in imitation of brick. Engineers have been trying for years to eliminate the joints in block pavements as far as possible so as to secure a perfectly smooth surface, with least resistance to traffic, least wear on pavement, least noise and least difficult to clean. It is the principle of the smooth surface, offering no point for wear to begin, that enables a well constructed sheet asphalt pavement to outlast, several times over, a block asphalt pavement with equal traffic. We believe that the unbroken "sheet" surface is one of the principal advantages of concrete paving.

The concrete base was mixed quite wet in a batch mixer, and spread and graded with shovels to pegs set from grade line stretched from curb to rail. The 1½-inch top course was then mixed (also wet) in the same mixer and spread within a few minutes after depositing base. Both base and top were made about as wet as they could be handled and still "stay put" without running to the lower grade at curb. The top was stroked off with a template, and then troweled with a circular motion of a long handled trowel by an experienced concrete finisher working from a bridge from curb to rail.

The contractors were J. H. Baker & Sons, of Port Huron, and they used the Baker patented protection plate for protecting the expansion joints. This plate consists of a strip of steel 3/16-inch thick by 2½ inches deep from which lugs about 5 inches long are punched to anchor it to the concrete. It is rolled to fit the crown of the pavement for transverse joints and left straight for longitudinal joints. The two steel plates are clamped together, face to face, by an iron clip, with a steel division plate of the required thickness between, and placed in position on the street. After pouring the concrete the division plate is removed and the joint filled with bituminous paving pitch.

Joints not protected with steel will soon wear down below the general surface of the pavement, making a bump for every passing vehicle. This is further evidence of the folly of blocking the whole surface.

The reinforcing in this case was used principally as a safeguard against cracking which might be caused by freezing of the clay subsoil. A little reinforcement is probably advisable in any case, to eliminate cracks from internal stresses developed in setting, settlement of sub-grade, etc.

As before stated, we cannot yet determine to what extent our pavement is a success, but it is sufficiently evident that it is not an entire failure.

The quantities and contract prices were as follows:

4,276 cubic yards of excavation, 30 cents per cubic yard.

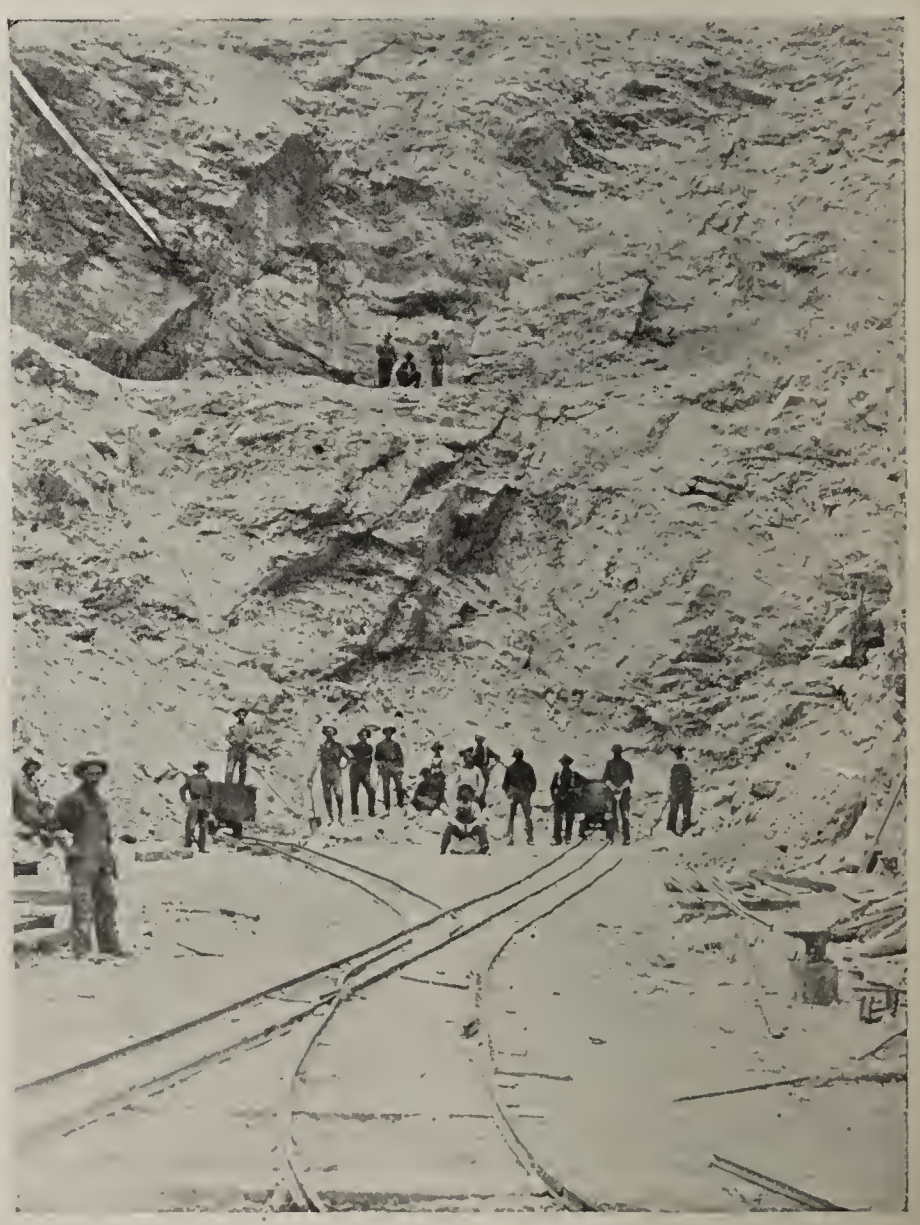
5,200 feet sub-drain, 15 cents per foot.

1,640 square yards paving, not reinforced, $1.12 per square yard.

9,055 square yards paving, reinforced, $1.22 per square yard.

Prices of materials and labor were as follows:
Cement delivered on street, $2.12 per barrel.
Gravel delivered on street, $1.25 per yard.
Sand delivered on street, $1.50 per yard.
Stone chips delivered on street, $3.35 per yard.
Common labor, $2.25 to $2.50 per day.
Finishers, $4.50 per day.
Teams, $4.50 to $5.00 per day.

It will be seen from the outline of our specifications that we made no attempt to confine ourselves to cheap construction at the expense of quality. The cost, however, is moderate, and present indications are that we will get very good value in pavement efficiency for the money expended.



A QUARRY OPENING ON GYPSUM DEPOSIT.

PLASTER MILL OF THE PACIFIC LIME AND GYPSUM COMPANY

Manufacture of gypsum wall plasters is now being undertaken on a large and modern scale for the first time in Oregon. The new factory is located at Gypsum, Oregon, where the 40-ton plant of the Pacific Lime & Gypsum Company has now in operation two of the four kettles.

The plant is reached over the northwestern branch of the O.-W. R. & N. out of Huntington, Oregon, or from Lime on the main line and a six-mile ride over the mountains. It is located on the west side of Snake river at the water's edge. The deposits cover practically 1,400 acres and contain an indefinitely large quantity of gypsum. They are worked, by the open bench system of quarrying. The face as exposed is 250 feet wide by nearly 100 feet high and is the largest gypsum quarry in the Rocky mountain and Pacific coast section of the United States.

From the quarry face the rock is conveyed in one-yard dump cars over an industrial track to the bunkers at the edge of the quarry floor, where the preliminary crushing plant is located. This plant consists of a "Jumbo" 24x36-inch jew Ehrsam nipper which breaks to a two-inch ring and feeds directly to a gyratory crusher which breaks, at the rate of 75 tons an hour, to a one-inch ring. The crushing plant is driven by a —— horsepower Westinghouse motor. The final product is carried by gravity into bins of 200 tons capacity at the upper terminal of a 6,000-foot aerial tramway. This carrying system operates under gravity with 36 buckets of 600 pounds capacity each. The weight of the loaded buckets passing down over the tramway is conserved to develop 50 horsepower at the quarry for the operation of the air compressor and the pneumatic tools. At the upper end of the tramway a bucket tender is employed to switch the empty buckets and load from the bins and throw back again to the cable, a process which usually takes 20 minutes, while at the lower terminal an automatic dump is employed. The lower terminal storage capacity is figured at 1,000 tons.

From the storage bin at the works the gypsum is discharged on to a 28-inch Leviathan belt conveyor, which delivers the rock to the feed hopper of the dryer. This rotating cylinder, 60 feet long by 8 feet in diameter and oil fired, serves to drive off practically all of the mechanically included moisture. From a concrete boot at the discharge end of the dryer the hot rock is raised by a steel bucket conveyor to an overhead screw conveyor, which carries the material along and feeds it as required to the 100-ton steel bins immediately over the Raymond pulverizers, manufactured by Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

The Raymond grinders are shown in the picture as being entirely enclosed, which is a feature of these machines using air separation under a Cyclone blower system. The pulverizers are rated at 10 tons each per hour, but under the present practice of producing a high percentage of fines, they are turning out about seven tons per hour. The products which the air pulls off will pass 96 per cent through No. 100 sieve and 87 per cent through a No. 200. Each Raymond is driven by a 100-horsepower Westinghouse motor.

From bins near the roof of the kettle room where the air separators have delivered the raw powdered gypsum it is fed by gravity to a screw conveyor, which feeds into the 50-ton steel bins over the kettles. The kettles, are 14 feet in diameter by 8 feet deep and hold 20 tons. They are oil fired through burners of the company's own design and make. When the remnants of the mechanically included moisture and that of crystallization have been expelled with the exception of 6.2 per cent the gypsum is said to be calcined and leaves the kettles at a high temperature and falls direct into concrete hot pits from where it is raised by steel buckets elevator and dumped onto a screw conveyor which feeds into the two long cooling bins on the upper floor of the mixing department.

The plaster is prepared and uniformly mixed by nine Broughton machines of one-ton capacity each and

THE 60-FOOT ROTARY.

discharged into Bates valve baggers, or automatic sacking and weighing machines, which are set to deliver exactly 100 pounds to each paper of jute bag as used. Each mixing and sacking unit consists of two Broughtons and one Bates, there being one extra Bates for the ninth Broughton; an individual 50-horsepower motor is required for each of these units. Direct from each Bates machine there is a package conveyor which places the bag in the car ready to be

VIEW OF RAYMOND GRINDERS AND PULVERIZERS.

finally placed by the loaders. Two important features in the manufacture of the plaster are covered by this system of loading, the expense of handling by hand and then to sack only as the call for shipment is made, thus ensuring a strictly fresh product for the market.

The burr hair picker operates with air separation and is considered by the manufacturers as one of the best machines, as it enables them to sell with a guarantee against hair balls.

The main building, which houses the drying, calcining and mixing departments of the plant, is of the best steel fireproof construction throughout and occupies a ground space 525x70 feet. It is entirely covered with corrugated iron.

The oil storage consists of four 25,000-gallon cylindrical tanks, which may be seen at the left of the general view of the plant. Two pumping systems are used in handling the oil; one takes it from the tank cars as they arrive over the railroad and the other puts it into the plant where it is needed at the dryer and kettles.

Additional buildings at the plant include a modern house for the general superintendent, J. C. McNaught, and some 20-odd cottages for the workmen. About 50 men are now being employed on one 10-hour shift. The company maintains an excellent water system of its own, pumping it first from the Snake into a receiving reservoir and filter basin and thence to a reservoir up on the mountain.

VIEW OF THE NEW PLASTER MILL OF THE PACIFIC LIME & GYPSUM CO., GYPSUM, OREGON.

The general officers of the company are: C. L. McDonald,, president, treasurer and general manager; W. A. Baker, vice-president; Roscoe C. Nelson, secretary, and Charles M. Palmer, chief chemist. The principal offices of the company are at 1101 Yeon building, Portland. The general sales agent and distributor for the firm is the Northwest Plaster & Lime Company, Portland, of which M. D. Wakeman is president and treasurer; L. R. Kollock, vice-president, and R. R. Brennan, secretary. A conservative estimate places the value of the annual output to the state of Oregon at $2,000,000. The manufacturers claim that the plaster is superior in that it possesses unusual plasticity and great sand-carrying capacity.

The company will soon put in a hollow plaster partition block plant just across the track from the present plaster mill. Construction is under way and the company expects to be ready in 60 days, turning out blocks at the rate of about 2,000,000 square feet per annum. Further development of the local deposits will shortly include a 500-barrel hydrated lime plant at the present lime works, Lime, Oregon.

E. U. Leh, formerly superintendent of the Cowell Company and now general manager of the Old Mission Portland Cement Company, San Juan, Cal., has been appointed general manager of the California Central Railroad, in conjunction with his present position.

GRAVEL AND STONE—QUALITIES, TESTS AND SELECTIONS

By A. T. Goldbeck

Read before the American Road Congress, Atlantic City

Of the many elements which make for the success of a waterbound macadam or gravel road, there is none of more vital importance than that of the proper selection of the stone or gravel entering its construction. The rock must be adapted to properly combat the conditions of traffic and the destructive elements of nature which it must encounter. Passing vehicles and horses' feet exert a pounding or impact action on the road surface and at the same time subject it to wear through abrasion. The result is a pulverization of the surface material, a necessary destructive effect since the integrity of the road is maintained through the cementing or binding power which the rock dust thus formed exerts on the larger particles of stone. Much of the powdered material does not remain in place on the road surface, but is washed away by the rains and is scattered in clouds of dust raised by the winds. The ideal condition is realized however, when the wear of travel produces just sufficient binder to hold the road stones together. When excessive wear grinds up too much fine material, dust and mud must develop. On the other hand lack of wear will produce too little dust to replace that lost through the mechanical action of the elements, and the larger particles deprived of their firm and binding support, become loosened by passing vehicles and the road surface ravels.

When heavy and continuous travel is to be carried, nothing but hard, tough rock of good binding qualities will give satisfaction, for should the stone be lacking in hardness or toughness, excessive dust in dry weather and a muddy surface in wet weather will be produced. Light and intermittent travel requires material which will more readily grind to powder in order that sufficient binder may be produced to replace that lost through the mechanical agencies of wind and rain. It would be just as unwise under most weather conditions to construct a lightly traveled road of hard, tough trap, as to build a heavily traveled road of soft friable limestone, since in the first case the road would ravel through lack of sufficient binding material to hold it together, while in the last case excessive powder would be formed with the production of a dusty, and sometimes muddy surface.

Agencies other than the mechanical action of traffic attack the road surfaces with destructive effect, and

most severe among these is frost. Although it is probable that the rock in the road surface is not affected very much by frost, the expansion, due to the freezing in a very porous surface, is considerable, making it all the more desirable in the selection of a road material to procure one with as high a cementing value as possible in order to form a dense impervious surface.

Physical Qualities of Road Building Rock

It will be recognized that road building rock must

A. T. GOLDBECK.

possess the following characteristics in order that the road surface may be preserved in good condition: It must be of sufficient hardness and toughness, and it must have good cementing or binding qualities.

The hardness of a road material measures its ability to resist the abrasive action of traffic in causing displacement of the surface particles by friction.

The toughness of a rock is a measure of its ability to resist rupture due to the impact of traffic.

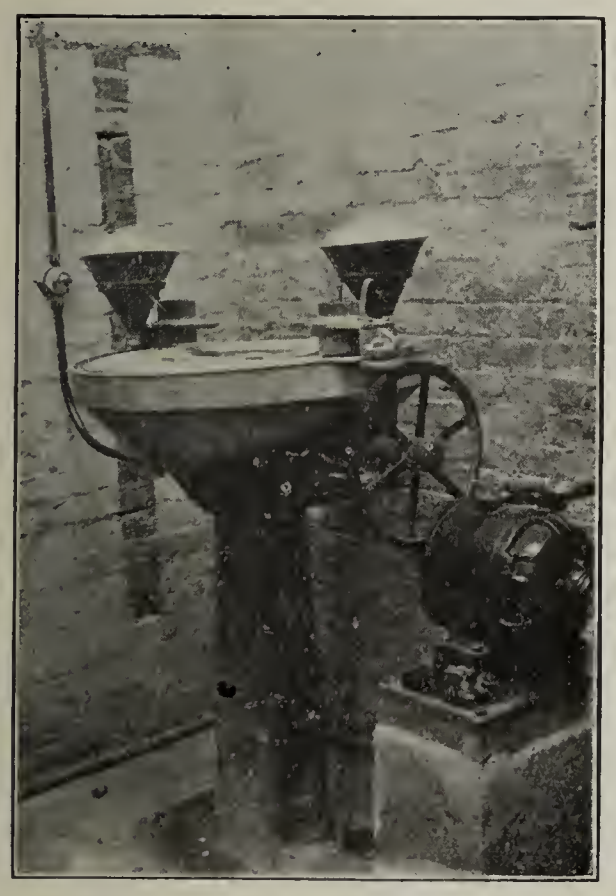


FIG. 1. DORRY HARDNESS MACHINE.

The cementing or binding power of a rock determines how firmly the individual stones will be cemented together by the rock powder formed through the action of traffic.

There is one other feature which is doubtless of much importance in judging of the probable bond of the rocks in a road surface; namely, the shape of the finer particles of the rock or screenings. Sharp angular particles, through their wedging, non-rolling effect, are doubtless more efficient in aiding the bond of a road surface than are fragments of rounded shape, and this factor should be taken into consideration in judging of the probable action of the road surface under traffic.

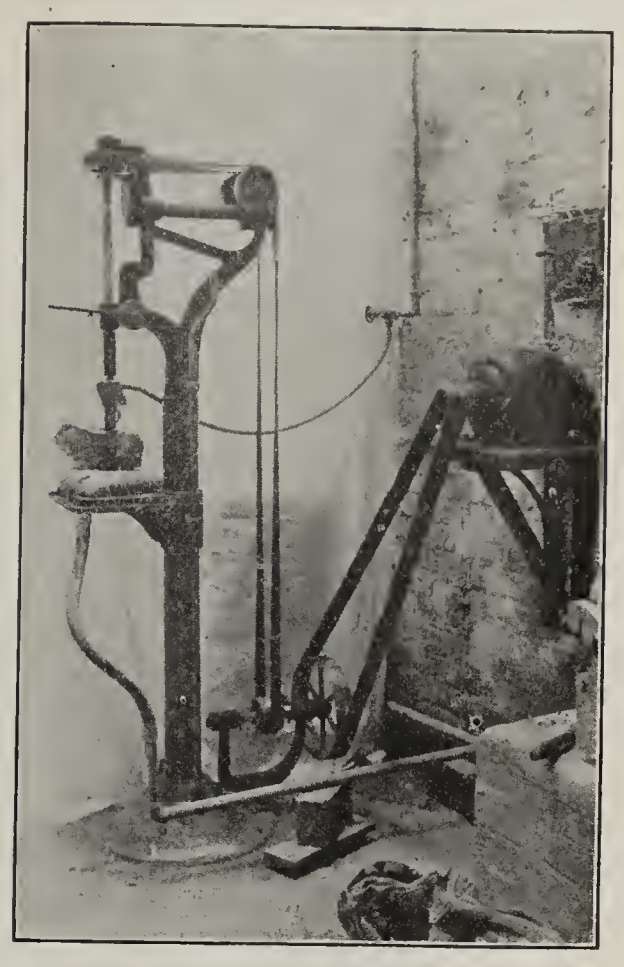


FIG. 2. DIAMOND CORE DRILL.

The Testing of Rock for Road Building

The testing of rock for road building has been carried on for over thirty years, the first systematic attempt to determine the relative value of road building rocks having been made in the French School of Bridges and Roads in 1878. It was here that the Deval abrasion test for rock was developed, and it is at the present time standard throughout the United States. Not until 1893 did this country begin the serious investigation of road materials, but during that year the Massachusetts Highway Commission established a laboratory in the Lawrence Scientific School of Harvard University under the direction of Mr. L. W. Page. In 1900, the United States Government installed a laboratory in the Department of Agriculture, and this is now a part of the organization of the Office of Public Roads, where the testing of road materials is undertaken without charge for any citizens of the United States who may apply for its services. The necessity for the investigation of road material has likewise led to the installation of testing of equipment in many technical institutions both in this country and abroad, and to the establishment of road material laboratories by many State Highway Commissions.

Physical Tests of Road Materials

The following tests are of value in investigating the physical qualities of rock for road building:

1. Hardness.
2. Toughness.
3. Resistance to wear.
4. Cementing value.
5. Specific gravity; and
6. Absorption.

Dorry Hardness Test. (Fig. 1.)

To judge of the resistance of rock to the abrasive action of traffic, a core one inch in diameter is cut from the solid rock by means of a diamond core drill (Fig. 2), and subjected to the grinding action of standard quartz sand, between a No. 30 and No. 40 sieve, fed on a revolving steel disc against which the test piece is held with a pressure of 1,250 grams. When the disc has made one thousand revolutions, the loss in weight of the sample is determined. In order

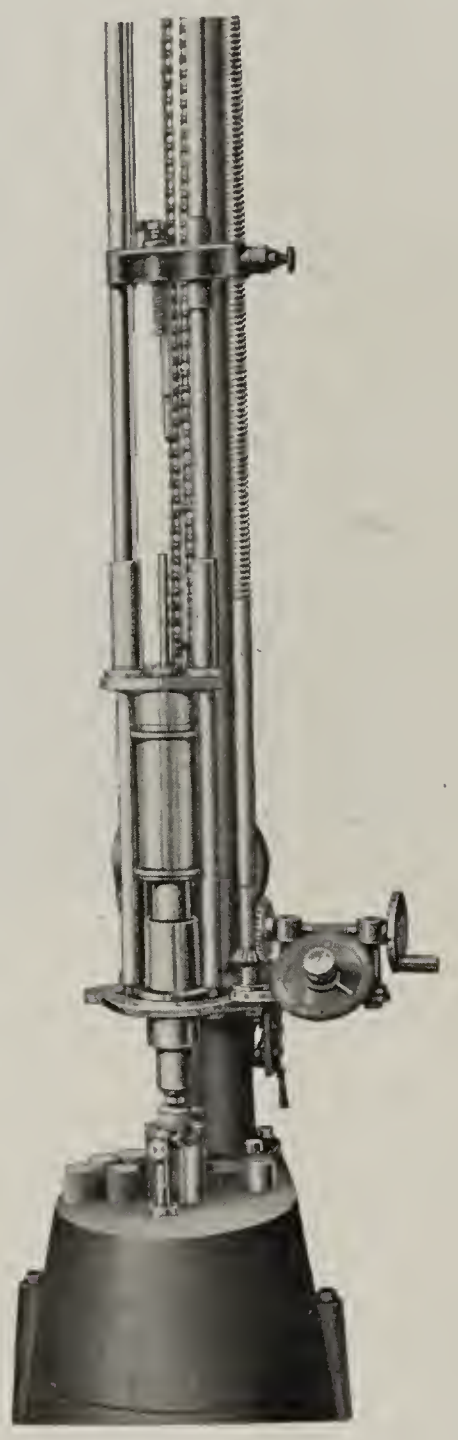


FIG. 3.

to report the results on a definite scale which will be convenient, the method has been adopted of subtracting one-third of the resulting loss in weight in grams from 20; thus a rock losing 6 grams has a hardness of 20 minus six thirds, or 18. Through a consideration of the results of hundreds of tests, the following interpretation of the hardness test seems to be a fair one: Below 14, rocks are called soft; from 14 to 17, medium; above 17, hard. The arbitrary constant 20 was selected with a view of giving the results of this test about the same range of variation as the French co-efficient of wear to be described later.

Toughness of Test. (Fig. 3)

To resist the severe impact of traffic on the roadway, road material must possess the quality of toughness to a high degree, and this quality is tested in a machine designed on the pile driver principle.

The specimen consists of a core 25 mm. (one inch) in diameter and 25 mm. high, cut from the solid rock by means of a diamond core drill and carefully faced off at both ends on a grinding lap (Fig. 4). A spherical ended plunger is brought in contact with the specimen and a two kilogram weight is allowed to fall on the plunger, thus approximating the blows of traffic. The height of the first blow is one centimeter and each succeeding fall is increased one centimeter in height until the specimen ruptures. The height of the last blow, which corresponds with the number of blows delivered, is taken as the index of the toughness of the specimen. This test was designed by Mr. L. W. Page, and has been adopted by the American Society for Testing Materials. In interpreting the results, rocks which run below 13 blows are called low; from 13 to 19, medium; and above, 19, high.

Abrasion Test. (Fig. 5)

The abrasion test, as performed in the Deval abrasion machine, tests the hardness as well as the toughness of rock, and since its development in the French School of Bridges and Roads, much valuable information has been obtained on the wearing qualities of rock. This test, which is a hardness and toughness test combined, acts as a very good check on the results of the separate hardness and toughness tests, and is performed as follows:

Eleven pounds (5 kg.) of broken rock between 1¼ and 2½ inches in size, 50 pieces if possible, are placed in a cast iron cylinder mounted diagonally on a shaft and slowly revolved 10,000 times. Material which passes a one-sixteenth inch sieve is considered as worn away, and the per cent of wear is calculated on this basis. The French coefficient of wear is obtained by dividing 40 by the per cent of wear. Thus a rock showing 4 per cent of wear has a French coefficient of wear of 10. The French engineers who were the first to undertake road material tests, adopted this method of recording results. They found that their best wearing rocks gave a co-efficient equal to about 20. The number 20 was, therefore, adopted as a standard of excellence. In interpreting the results of this test a coefficient of wear below 8 is called low; from 8 to 13, medium; from 14 to 20, high; and above 20, very high.

Page Impact Cementation Test. (Fig. 6)

The cementing power of a road material is the property possessed by the rock dust or other finely divided material to act as a cement on the coarser fragments composing the road. This property varies greatly with different kinds of rock, and the absence of cementing power is so pronounced in some varieties that they can never be made to compact under the roller. Other rocks bind together very readily and form a firm, imprevious surface, very highly resistant to the wind and rain and raveling action of traffic. The method of testing the cementing value of rock dusts is as follows:

One-half kg. of the rock to be tested is broken sufficiently small to pass an ½-inch mesh sieve. This material is placed in a ball mill (Fig. 7), together with 90 cc. of water, sufficient to produce a stiff paste after grinding. The mill contains two steel shot weighing about 20 pounds each and is revolved at the rate of 2,000 revolutions per hour. At the end of 5,000 revolutions the material is removed from the mill and compressed into briquettes 25 mm. high and 25 mm. in diameter under a pressure of 132 kg. per square centimeter.

After drying for 20 hours in the air and 4 hours in a hot air bath at 200 degrees F., the specimens are allowed to cool in a desiccator and are tested in a spe-

cially designed impact machine. The test consists in allowing a 1 kg. weight to fall through a height of 1 cm. on a flat end plunger which rests on the specimen. The number of blows required to destroy the specimen is taken as the cementing value of the material. Below 10, the cementing value is called low; from 10 to 25, fair; 26 to 75, good; 76 to 100, very good; above 100, excellent.

Absorption

The absorption is obtained by immersing a small sample, weighing about 10 grams, in water for four days, noting the gain in weight during that period, and finally expressing it in pounds of water absorbed per cubic foot of solid rock.

Interpretation of Laboratory Tests

The following facts should be taken into consideration before attempting to interpret the results of the laboratory tests on samples of rock intended for use in macadam road construction; namely:

FIG. 4. GRINDING LAP AND DIAMOND SAW.

1. The character of the traffic to which the material is liable to be subjected, whether (a) automobile, or (b) horse-drawn and if so, whether (1) heavy, (2) medium, or (3) light.
2. The character of the material under examination, that is, (a) its name, and (b) its approximate mineral composition and structure.
3. The behavior of material of a similar nature in actual service.

A knowledge of these three points is essential to an intelligent interpretation of the laboratory tests in any specific instance.

1. **Character of traffic.**

Waterbound macadam, in general, is not practicable where much automobile traffic exists, but is only suitable for horse-drawn travel. Assuming the traffic to be principally horse-drawn, it is well to know whether it is heavy, as in the vicinity of large cities; medium, as on the principal highways; or light, as on park or less important roads.

2. **Character of Material.**

In order to compare a material under test with similar materials in service, it is of value to know the name and character of the specimens.

3. **Behavior of Similar Rock in Service.**

Laboratory tests can do little more than approximate the conditions of traffic, and in order to correlate the results of these tests with the behavior of the material in service, it is necessary to have a knowledge of similar material under service conditions.

TABLE OF LIMITING VALUES

Character of Traffic.	Per Cent. of Wear.	Results of Tests Hardness.	Toughness.
Heavy	12.5 or less	18 or over	19 or over
Medium ...	2.5 to 5	14 to 18	14 to 19
Light	5.0 to 8	10 to 14	8 to 14

The cementing value should in general run above 25 for all classes of traffic, except in specific cases, as noted below.

PHYSICAL CHARACTERISTICS OF ROAD BUILDING ROCKS

Trap

The trap rocks including the usual varieties of diabase, basalt, andesite, diorite, and gabbro are particularly well suited for roads subjected to heavy teaming on account of their high resistance to wear, hardness and toughness. They bind well on the road, provided the traffic is heavy enough to supply by wear enough fine material to replace that lost by natural causes. As a whole the traps are better suited for the construction of macadam roads subjected to moderately heavy traffic than any other road making rock.

Limestone and Dolomite

Limestones as a rule are not very hard or tough, but possess a good cementing value and show low-medium resistance to wear. Limestones are therefore not suited for the construction of waterbound macadam roads which are subjected to very heavy traffic, since this class of traffic will wear away such a road too quickly. For the construction of roads subjected to light or medium-light horse-drawn traffic, however, limestone is a material which is almost ideal.

Limestones in their physical characteristics are very much alike, although the crystalline limestones are least suited for road building because of their low toughness, which property renders them liable to fractures under the impact of traffic. The indications are that the siliceous limestones are those best suited for macadam construction.

Granites

The granites are generally lacking in toughness and binding power, and are therefore unfit for use as a class in any but the foundation courses in macadam roads. Although they sometimes show good cementing qualities in the laboratory, particularly the material which is highly altered, experience has shown that it should not be used for surfacing on account of the ease with which it disintegrates under traffic.

Sandstones

Sandstones are extremely variable in their physical characteristics. Some of them are hard and tough, while others are very likely to fracture under impact. As a class they do not bind well in the road, and for this reason they should be used only for the foundation course when their hardness and toughness is sufficient to warrant their use for this purpose.

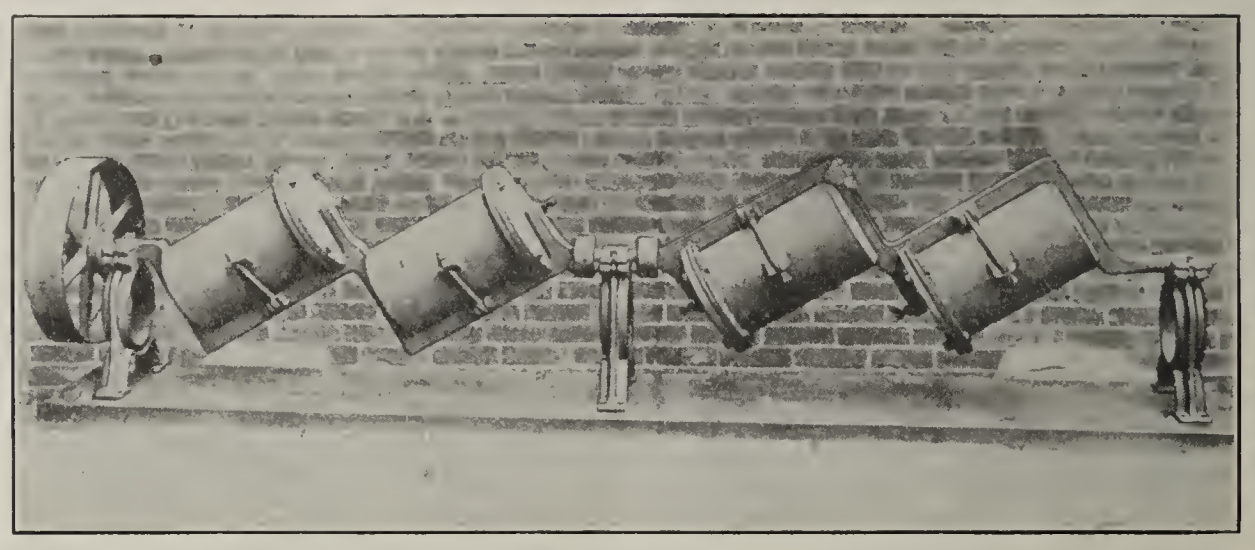


FIG. 5. DEVAL ABRASION MACHINE.

Chert

Chert is a very hard material and usually shows good resistance to wear. It makes excellent material for the construction of macadam roads, as it invariably binds together well.

Gneiss, Schist, and Slate

Gneiss, schist, and slate are very unsatisfactory materials for road construction because of their foliated structure which renders them extremely subject to fracture under impact. They should not be used in road construction when a better material is available.

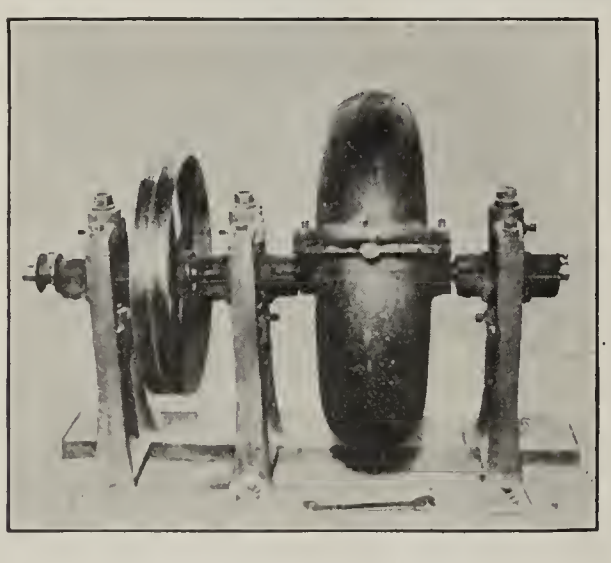


FIG. 7. BALL MILL.

Marble and Quartzite

Neither marble nor quartzite is of much value to the road builder for the wearing courses of macadam roads. Marble, on account of its crystalline structure, is lacking in toughness, while quartzite is a poor road material on account of its extreme hardness and lack of binding power.

CHARACTER OF ROCK FOR BITUMINOUS CONSTRUCTION

Bituminous binders afford great protection to the stone used in bituminous construction, when the road is properly maintained with a surface paint coat of bitumen. The surface mat and the bituminous binder between the stones prevent the grinding up of the stone portion of the wearing surface and likewise reduce the effect of shock or impact on the rock in the body of the road. It seems to be a fact that stone which is so low in hardness and toughness that it cannot be used in waterbound macadam, may be used with perfect success in bituminous work. The bituminous binder renders it possible to use many rocks, such as sandstones, schists, quartzites, marble, etc., which do not bind or are too friable for the construction of waterbound work. Although some rocks crush up into fragments whose sides are too smooth to offer a perfect bond for the bitumen, it is probably true that almost any rock which will not crush up too much under the roller is suitable for use with a bituminous binder.

Gravel

The term gravel, as applied to road building, is one which has different meanings in different sections of the country, and conflicting ideas seem to exist as to what class of material should be included in the term. Thus, what in parts of the country would be called coarse sand, would be termed gravel in other sections. Again the word is sometimes made to include material ranging from the finest particles to the coarsest shingle and boulders.

From the standpoint of the road builder, gravel should be composed of the products of rock, disintegration ranging in size from finely divided clay up to the largest pebble which may be used in construction, which, in general, should not be greater than 2 inches in largest dimension.

In the selection of a road building gravel there are several very important characteristics which should be investigated, and these are:

1. **Character of rock composing the fragments.**
2. Shape of the fragments.
3. Relative grading of the different sizes of particles.
4. Amount and character of the finely divided or binding material.
5. Cementing qualities of the material.

1. **Character of rock composing the fragments.**

Just as in the case of a waterbound macadam road, the durability of the wearing surface of a gravel road is dependent in part on the hardness and toughness of the stone of which it is constructed. Gravel being composed of waterworn or glacial-worn rock fragments, is made up of various types of rocks, some of which are not entirely adapted for road construction because of the ease with which they grind up under traffic. Thus the limestone and sandstone gravels, and those composed of macaceous fragments are less

durable than those made of fragments of trap or granite. A laboratory inspection of gravel should therefore include a determination of the character of the fragments composing the sample, and this in most cases may be done by a superficial examination of a sufficient number of particles fractured for the purpose.

2. **Shape of the fragments.**

The shape of the pebbles should be considered since it is doubtless true that fragments of angular character furnish a more effective mechanical bond than do rounded pebbles, and where a choice lies between two gravels equal in other respects, the sharper, more angular particles should be given the preference.

3. **Relative grading of different sizes of particles.**

Gravel which is graded in size so that the smaller pebbles fit into the interstices between the larger ones is much denser and more stable in the road than that which is composed of all fine or all coarse material. Graded in this way, gravel requires much less binding material and presents a more durable wearing surface which is less likely to ravel or become muddy and dusty than that in which more fine binder is required.

To determine the grading, a sieve or mechanical analysis is made. This is done by passing a dried sample of the material through sieves of different sized mesh and determining by weight the amount retained on each. The sieves in use in the Office of Public Roads have circular openings of the following sizes: 2-inch, 1½-inch, 1-inch, ¾-inch, ½-inch, ¼-inch, ⅛-inch, and those with 10, 20, 30, 40, 50, 80, 100, and 200 meshes per lineal inch. Sieve analysis furnishes a means of judging whether the gravel might not be improved by screening out the fine material or perhaps by combining it with material from another source to give it a more uniform grading. It is a useful test in judging the presence of too much sand which might have the effect of creating a loose unstable road surface.

4. **Amount and character of the binding material.**

The binding material in gravel, as a rule, may consist of the powdered rock itself, or clay, loam iron oxide, silica, etc.

Clays are of variable binding qualities and a very quick rough determination of the binding power may be made by moistening a small amount of clay between the fingers and noting whether it has a sticky or gritty feeling. The sticky or fat clays are of good cementing qualities. Ferrugineous clays are very good binders and, invariably, gravel containing fine material of this character cements together exceptionally well on the road. If the stones composing the gravel grind up into dust which is high in cementing qualities this dust makes the best kind of a binder. It is for this reason that trap rock gravels make such excellent road materials since they possess cementing qualities as well as durability.

Gravels composed of poor binding materials, such as quartz, sandstone, granite, etc., must always have binding material mixed with them in amounts not to exceed about 10 or 12 per cent. It is far better to have too little than too much binder since much fine material will be formed through the grinding of traffic.

The amount of binder in a sample of gravel may be obtained by washing out the fine material, evaporating the wash water to dryness, and weighing the residue which may be considered as cementing material.

5. **Cementing qualities of the material.**

The cementing value of the binding material is obtained by grinding it with water in a ball mill, forming it into briquettes and subjecting it to the impact cementing test as practiced on crushed rock samples.

FIG. 8. BRIQUETTE FORMING MACHINE FOR CEMENTING VALUE TEST.

A preliminary investigation of road materials, by means of laboratory tests, furnishes information of great value to the road builder. From the test results not only can judgment be formed regarding the probable suitability of the material for the purpose intended, but the relative worth of a number of samples can be determined, thus rendering it possible to make a more economic selection of rock or gravel from several available sources of supply.

LINK-BELT CONVEYORS.

The Link-Belt Company has just published a new booklet entitled "Link-Belt Conveyors for Sand, Stone, Gravel, etc." It shows some of the Company's rugged installations of continuous bucket elevators, and stone carriers and numerous equipments used by contractors and dealers throughout the country. Probably the most interesting page to sand, stone and gravel dealers, as well as contractors, is the new Link-Belt Portable Gondola Car Unloader which it is claimed will unload a railroad car at the rate of 50 tons an hour. It is made either portable or stationary and several equipments have already been installed in Philadelphia. Copies of the new booklet, we understand, will be mailed to interested parties, on request to the Link-Belt Company, Philadelphia or Chicago.

Constructing a Ten-Story Concrete Building

One of the largest factory buildings in the United States is now being constructed near the Pennsylvania Railroad tracks at the end of the Queensboro bridge in Long Island City, N. Y. It is a 10-story 430x200-foot concrete structure to be used by the Loose-Wiles Biscuit Company under a lease from the Degnon Realty & Terminal Improvement Company. The building will contain nearly 1,000,000 square feet of floor space, and its construction involves about 35,000 yards of reinforced concrete, 4,000 tons of structural steel, 2,500 tons of reinforcement bars and 80,000 barrels of cement. Neither in the design nor in the method of construction are conventional practice or routine operations strictly followed, but special effort has been made to take advantage of the most economical selections and combinations of materials and adaptation of conditions to rapid and efficient construction.

SIXTH FLOOR CONSTRUCTED AND COLUMNS ERECTED TO EIGHTH FLOOR, AUGUST 12th.

Owing to the heavy loads imposed it was found desirable to use structural steel for the interior columns in the lower stories. The rear walls are of brick, while the remaining walls are veneered with white terra cotta. The floors are designed for loads of from 150, 200, 500 and 3,000 pounds per square foot. The basis of design for the reinforced concrete construction is the reinforced concrete regulations of the Borough of Manhattan issued December 28, 1911, and now in force in all five boroughs of Greater New York.

Design

The columns are supported on 256 concrete piers with pile foundations to cover 80 per cent of the total area of the lot, as described in the Engineering Record of May 31, page 606. The dimensions of concrete columns required to support the very heavy floor loads in the lower stories would be so great as to produce serious obstructions and waste valuable space in the building. Structural steel columns are therefore used up to the seventh floor, above which all columns are of reinforced concrete.

All of the exterior columns, which are substantially wall piers, are of reinforced concrete, with rectangular sections having maximum dimensions of 6x2½ feet, one of them about 19 feet high in the basement story containing 13 yards of concrete.

A large part of the seventh floor is occupied by a set of English ovens, two stories high, extending through the eighth floor. They contain more than 1,000,000 bricks, and their side walls weigh about 16 tons per linear foot. They are supported directly on plate girders riveted to the columns and inclosed in solid masses of concrete. All of the other floors and the roof have reinforced concrete slabs, beams and girders, the latter being supported by brackets on the interior columns, which are inclosed in solid concrete with a minimum thickness of 4 inches beyond the steelwork.

Each floor is accessible through six elevator and stair shafts, the latter being provided with smoke vestibules with reinforced concrete walls having two doors leading into the main room and one door into the shaft. The upper parts of the vestibule windows are fitted with open louvres, affording smoke ventilation in case of fire. The steel frame windows at these shafts are glazed with wire glass, but the other windows, not being adjacent to nearby buildings, are glazed with plain glass and have wooden frames. The panels between the wall piers have very large windows, the spaces around them being filled with brickwork faced with white glazed tiles. Where wooden floor surfaces are required the concrete slabs are covered with 7½x3-inch splined yellow pine planks with a wearing surface of 1⅛-inch maple boards.

Construction Progress

The construction of the basement columns was commenced in May, soon after the completion of the foundation piers, and the first floor was completed about July 25, some delay having been occasioned by the necessity of waiting for the steel columns to be erected in advance of the concrete work. Since June 28 the construction has progressed at the rate of about four full stories in six weeks. The basement columns, in 1-story lengths, and the upper sections, in

3-story lengths, are erected by two steel guyed derricks, which keep them erected three stories in advance of the concrete work.

The 1:2:4 concrete is made of Knickerbocker Portland cement and aggregate furnished by the Phoenix Sand and Gravel Company. It is unloaded from scows by a Brownhoist crane with a clamshell bucket, which delivers to 4-yard side-dump cars, in which it is drawn by locomotives to the site.

The surface of the ground slopes from about the level of the second floor at the north end of the building to the level of the ground floor at the south end, a circumstance the advantages of which have been utilized in the installation of one of the concrete mixing plants, which is located just outside the building about 100 feet from the north end. The level of the industrial tracks on which materials are delivered is about 12 feet above the ground floor, and cement in sacks is unloaded directly from the cars to the floor of a roofed cement platform, where it is stored and whence it is chuted to the charging platform of the mixer. Gravel is dumped into fourteen small bins with their floors pitched about 40 degrees to vertical sliding steel gates 30 inches above floor level. Through these gates the gravel is discharged into carts of 6 cubic feet capacity, which transport it to the Ransome mixer, where four loads of gravel, two of sand and five bags of cement are charged for one batch. Because the sand is too wet to flow readily through bins like the gravel bins it is dumped from the cars to a platform and then shoveled into the carts serving the mixer.

The mixer is set in a pit so that the top of the charging hopper is on a level with the charging floor, which slopes slightly from the bins, thus facilitating the movement of loaded carts. The mixer discharges to a bucket elevated in an automatic Ransome hoist tower, which is extended as required to correspond with the successive stories. The buckets are automatically dumped in the usual manner to carts distributing the concrete to all parts of the building. The hoisting bucket is suspended from two lines, one of which leads directly from the top of the tower to the electric hoisting engine, while the other passes over a sheave, also at the top of the tower, and is attached to a counterweight that nearly balances the empty bucket, reduces the danger of dropping the bucket too rapidly, and is considered to effect an important saving of wear and tear due to the use of the brake.

Concrete Mixing Efficiency

The mixing crew is composed of four men wheeling gravel, two men wheeling sand, four men shoveling sand, two men handling cement at the mixer, three men handling cement at the storage platform, two men trimming gravel in the bins, one man operating the mixer and one man operating the hoist, making a total of 19 men who have handled ten 35-cubic foot batches of loose material in 11 minutes recorded time, and have made in 8 hours a run of 349 batches of 35 cubic feet of loose materials.

Another 1-yard mixer, located 100 feet from the opposite end of the building and on the same side, is installed where the level of the ground is nearly the same as that of the first floor of the building and did not afford any opportunity for handling material by gravity. Sand and gravel were therefore dumped on the ground, shoveled into barrows and wheeled to the mixer, with the result that for this mixing machine of the same capacity as the one already described there was required a crew of four men wheeling gravel, two men wheeling sand, three men shoveling sand, twelve men shoveling gravel, three men handling cement at tracks, two men handling cement at the mixer, two men trucking cement, one man operating the mixer and one man operating the hoist, making a total of 30 men who handled ten 35-foot batches of loose material in fifteen minutes and thirteen seconds, and made a run of two hundred and eighty-six batches in eight hours.

Although it was recognized that the mixing by this machine was much more expensive than by the other machine, it was not considered desirable to install a gravity apparatus, that would have been necessary to make the outputs correspond, because a careful estimate showed that the saving in expense of mixing the amount of concrete required to be handled by this plant did not quite equal the cost for installing a trestle for the delivery of materials at a greater height and the construction of the necessary bins. The best record yet made is mixing and placing 550 yards of concrete in eight hours.

Columns

The columns have I-shape cross-sections fitted at each corner with a light vertical flange made of steel folded double with edges bent to engage the flange plates of the column. The flanges project about 3 inches beyond the structural steel, make angles of about 45 degrees with the cover plates and are connected by bent steel bars bolted to them. The doubled outer edges are slotted at intervals of about 4 inches to receive a spiral wire wound around the columns to act as anchorage for the inclosing concrete. Every interior column is inclosed by a guard made of two bent sheets of No. 18 gage steel, protecting the exterior face of the concrete to a height of 5 feet above the floor. Special timber sills are clamped to the columns just above the finished floors to receive the erection derricks and support them clear of the concrete slabs, thus relieving the new concrete from heavy loads.

Forms

Forms for the floorslabs, beams, girders and columns are used about ten times each and are made of ⅞-inch boards for the floorslabs, 1¼ inches for the sides of the beams and girders and 1¾ inches for the bottoms of the beams and girders and of 4x4 inch for the posts. Together they required two carloads of nails. The forms for the columns are made with single panels for each side assembled with exterior bolted yokes made of 4x4-inch and 6x4-inch timbers. All of the beams, girders and slab forms are made complete in single pieces, removed and replaced as units. They are handled by three movable towers, each of them mounted on casters.

The tower is a timber structure about 25 feet high, pivoted below the center of gravity to a pyramidal framework fixed to the moving platform. A hand windlass is bolted to the tower below the pivot and serves as a counterweight. When not in service the tower is revolved to a horizontal position and can be moved throughout the building, with plenty of clearance from the floor above. When in service it is easily revolved to vertical position and is ready for hoisting and lowering the forms, which is easily accomplished by two men. Light wooden tripods with hand windlasses attached to them are located on the floor adjacent to the four hatchways in each story, and are used for hoisting material.

With a force of about four hundred men working one eight-hour shift daily the work is progressing rapidly. The forms are stripped when the concrete is about four days old, and the beams and girders are shored up and supported for about three weeks longer. Special provision is made in the exterior walls and wall piers for about three thousand outlets for electric lamps which will be provided to illuminate the exterior of the building.

Bending Reinforcement Steel

The concrete is reinforced by about 2500 tons of Havemeyer and twisted bars up to 1¼ inch square, all of which are bent at the site by two power-bending machines designed by Mr. R. C. Wilson, engineer for the contractor.

Stirrups and small rods are bent in sets of eight in a machine having a table provided with lever arms and adjustable pins operated by belt-driven gearing, which will make four bends in a set of rods in about ten seconds. The heavy rods, such as the moment bars in beams and girders, which are made with four oblique bends connecting the portions in the top and bottom part of the girder, are placed horizontally with their ends engaging two steel-lined slots in a rigid framework. The center of the bar engages bearings in the same plane on a car which is moved forward by a link motion driven by the same motor that operates the other bending machine, and is returned by a counterweight. This machine bends the heaviest rods singly at the rate of about one hundred and twenty pieces per hour. The rods are delivered from the bending machines to the building on a special four-wheel truck and are hoisted to the required elevation by two derrick booms mounted on a wooden tower similar to those used for the concrete elevators.

Mr. William W. Higginson was the architect for the buildings. The Degnon Contracting Company is the owner and lessor and was the contractor for the foundations. The general contractor for the building was the Turner Construction Company, of New York City. The structural steel work was fabricated and erected by Post & McCord, of New York.

THE BRADLEY 66 INCH THREE ROLL MILL

The Bradley Pulverizer Company of Boston, Mass., has requested us to announce that they are now in a position to take orders for their new preliminary grinder, which is to be called the Bradley 66 Inch Three Roll Mill. This mill is probably the largest pulverizing unit ever manufactured. It weighs 45,000 pounds, is 11 feet 1½ inches high. The diameter of the die ring is 66 inches, three 2-inch rolls are used, which weigh 950 pounds each. The mill is designed to run at 125 revolutions per minute, which gives a pulverizing effect at about 11,000 pounds on each roll.

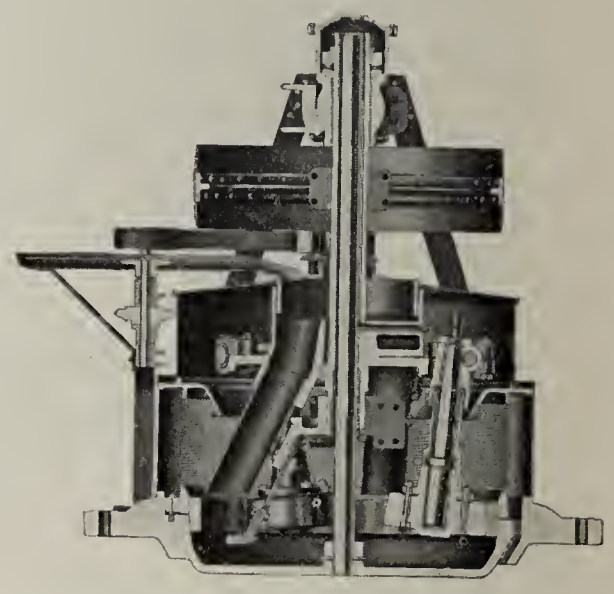
The principle of the grinding of this mill is very old, but the method in which the Bradley Pulverizer Company has applied same makes it the most economical principle of grinding obtainable. They claim that the mill is very simple to operate, using a plate or disc feed and takes feed direct from a No. 5 crusher when breaking down limestone for tube mill feed.

One mill has been in operation for almost two years. It has been grinding limestone in the Lehigh Valley District, and has shown an average of from 35 to 40 tons per hour and has never been pushed to its limit. The fineness has been 53 per cent through a 100 mesh screen, and the horse power consumed when grinding 40 tons per hour has been about 200. Another mill which has been in operation at the plant of the Riverside Portland Cement Company, Riverside, Calif., has been used for breaking down clinker for tube mill feed, taking the clinker same size as it comes from the kilns and producing about 125 barrels per hour, 55 per cent through a 100 mesh screen and using about 145 horse power.

This mill is an absolute success, having been thoroughly tried out in every manner possible. The output and fineness has run uniform on every test. The simplicity of the mill certainly commends its use to cement manufacturers who have been using complicated machinery in the past. The wearing parts are few. They are easily and cheaply replaced and are accessible. All bearings are dust proof.

For the plant that requires double stage reduction we know that there is no other mill of like capacity nor is there any other mill now manufactured that will produce material of like fineness for tube mill finish with as low a horse power consumption per ton of rock ground, at as low a cost for maintenance. We expect that it will revolutionize the grinding departments of many of the larger plants. It is sure to take the place of higher upkeep mills. The manufacture of cement is really a grinding proposition and if the cost of this manufacturing is to be lessened, it must be accomplished in the grinding departments by using the most economical machinery obtainable. On such tests as we have been able to make we believe that the upkeep of this mill will be somewhere in the neighborhood of one cent per ton, possibly a little less, but we are quite sure that it will not run over this estimate.

As before stated, this mill is a preliminary grinder only, and is not to be classed as a finisher. We believe that there is no mill that can take the place of the Giant Griffin Mill as a finisher, but there are some plants that are partial to double stage reduction, and it is this class of manufacturers we desire to reach with our new mill. The statements which we made above are conservative, they are based on actual tests. It is our belief that the mill will even do better than this if it is pushed to its utmost. We do not think



BRADLEY 66-INCH THREE-ROLL MILL

this will be necessary however, and we are equally sure that the cement manufacturers will agree with us if they will investigate our statements.

We will be very glad to give the name of the company that is using the mill on raw material in the Lehigh district, to parties desiring same. As stated above that the Riverside Portland Cement Company is using one mill on clinker, and we will be very glad to have anyone write these people and obtain direct from them their views on this mill as a preliminary grinder.

The Lake Cicott Sand & Gravel Co., of Logansport, Ind., has equipped itself with a thoroughly modern screening and washing plant. As this is the only one on any division of the Panhandle railroad lines in Northern Indiana, the company is in a position to supply dealers and contractors with the best quality of material for plastering and concreting purposes directly obtainable in that section of the country.

Methods for Testing Concrete Waterproofing

By Cloyd M. Chapman

So much that is contradictory has been said and written concerning various methods of producing concrete which is waterproof, and so much has been claimed by the makers of various compounds which have been offered to the public as a positive solution of all water-proofing problems, that it is not surprising that not one cement user in ten has any definite or fixed opinion as to how to meet the problem of producing a waterproof concrete. There seem to be as many opinions on the subject as there are men willing to express their opinions. And the many methods which have been used differ greatly from each other. They are not all bad, for some of them have been very successfully applied. They are not all good, for many failures have occurred.

Every little while a new preparation is offered or a new method is advocated. There seems to be no strong tendency toward any one method of producing a waterproof concrete. Perhaps the reason for this continued uncertainty and diversity of opinion among cement users may be found in the very fact that many of the multitude of methods advocated have, in certain instances, proven successful and each success makes converts to the method used. In many cases in which special compounds have been added to a good, well proportioned concrete made of properly graded materials, there is little doubt that the result would have been satisfactory if the special compound had been entirely omitted. In other cases where the concrete is made of materials not wholly adapted to the purpose an addition of a suitable filler or special compound would have produced the desired waterproof qualities.

To throw more light upon the effectiveness of the various methods of waterproofing concrete, a great many tests have been made by numerous investigators. The methods used by these experimentors have ranged from absorption tests to high pressure tests necessitating more or less elaborate apparatus.

Non-Pressure Tests

The absorption or non-pressure tests are made by preparing specimens of any predetermined size and shape of the concrete waterproofed by the particular methods under investigation. After the desired age is attained these specimens are either immersed in water completely, or immersed almost completely, placed in shallow water so that the bottom only of the specimen is wet. By one method, the specimen may be made cup-shaped so that the water may be placed in the depression in the specimen. As a development of this a container for the water is sometimes attached to the surface of the specimen. The two last mentioned forms of tests have been extensively used in the laboratory of Westinghouse, Church, Kerr & Co.

In all of these forms of tests the results are expressed in terms of the amount of water absorbed, or the rate of absorption.

Pressure Tests

In the pressure tests the specimen is either so made that the water pressure may be applied to the interior of the test piece or it is so made that it may be inserted in the apparatus in such a manner that the water pressure may be applied to a certain area on one face of the test piece. In this form of test the results are expressed in terms of the amount of water passing through the specimen or the rate of flow through it.

Both of the above classes of tests are very valuable if carried out in such a manner that the results may reasonably be expected to compare with results which may be obtained in practical work. To this end it is desirable that certain precautions be observed in preparing specimens and conducting tests so that the results shall not be misleading or deceptive.

It is the purpose of this paper to call attention to some of the features of tests of this class which should receive particular attention and to emphasize more strongly certain precautions, failure to observe which may cause some of these tests to give very deceptive data. These precautions apply particularly to tests made for the purpose of determining what method shall be used on a particular piece of work in the field. Some of them do not apply to tests designed to compare the relative efficiency only of various methods without regard to any particular work at hand.

First: The selection of the materials to be used in making up the test pieces: These should be selected from those available at the site of the work which is to be done. This is particularly true of the fine and the coarse aggregates. It has more than once happened that tests made with suitable aggregates have shown a particular method to give a waterproof concrete but the same treatment failed when the aggregates available in the field were used. If, therefore, it is desired to determine by test how to produce a waterproof concrete for a particular job, the materials available at the job should be used in making up the test pieces. It is also important in connection with the selection of aggregates that there be secured a sufficient quantity of the materials to be used to conduct the entire line of tests contemplated so that there need be no change in the materials used.

Second: The proportioning of the materials: This should be done with a view to determining the proportions to be used later on the work. The proportions to be used on the job should be used in the tests. There is little use in testing a 1:2:4 concrete for water tightness and then use 1:2½:5 on the job.

Third: The mixing of the materials: This should duplicate as nearly as possible the mixing to be used on the work. Many a well-mixed concrete has proven waterproof which would have failed utterly if carelessly mixed. There is liable to be a tendency to mix very thoroughly concrete for a test and then make no special provision for thorough mixing on the job.

Fourth: The consistency of the mixture: This should be carefully considered because of its influence upon the results. A consistency should be chosen which it is practical to use on the job under the circumstances prevailing there. For instance, it is useless to test a concrete of so thick a consistency that it would have to be spaded into the forms, if on the job the concrete is to be spouted from the elevator and therefore necessarily of a much thinner consistency than was used in the test.

Fifth: The molding of the test specimen: This process should imitate as nearly as possible the filling of the forms as that will be done on the job. To make a test piece by putting into the mold a small quantity of concrete at a time and constantly tamping during the filling process would probably produce a deceptive result.

*Presented before the National Association of Cement Users, Pittsburgh.

Sixth. The finishing of the surface to be tested: This is one of the most important points in the preparation of test specimens. The condition in which that surface which is to be subjected to water is left has a very great influence upon the results obtained. For instance, it is quite possible by means of a little troweling to produce a skin or surface coating of nearly neat cement. This will produce a dense surface much more nearly impermeable than the body of the concrete and show results far superior to an untroweled specimen of the same concrete. It is recommended that specimens be so prepared that the surface exposed to test truly represents the body of the concrete. This may be accomplished by removing the surface of the specimen after the concrete has hardened by means of a wire brush or by chipping or breaking off the surface before test.

In the case of absorption tests, this may be done with a stiff wire brush when the specimen is about 24 hours old. In the case of the pressure tests that portion only of the surface which is to be subjected to the pressure and that portion from which the water passes out of the specimen need to be removed. This may be accomplished by making the test piece with additional material added to the surfaces to be tested so that this additional concrete may be broken off after the specimen has hardened and before the test is performed. Unless some such precaution is taken, tests of this character are liable to show the efficiency of the surface of the specimen in resisting the water pressure rather than the value of the mass of the concrete in performing the same function.

WATERPROOFING TEST SPECIMEN WITH EXPOSED SURFACES

Recommended Test Specimen

One suitable form for a specimen for pressure tests is shown in the accompanying sketch. It is in the form of a central disc a of suitable diameter and thickness. The outside surface and the outer portion of the two faces of this disc are molded smooth and regular so as to fit the receptacle or holder into which it must be placed in order to apply the water pressure to a definite and restricted area of its surface. From the central portion of the two faces of this disc project truncated cones b and d the smaller diameter of which is just equal to the diameter of the circle which is to receive the water pressure. After the specimen has hardened and is ready for test, the two truncated cones are broken off with a blow of a hammer, leaving a disc such as is shown at c.

By this method there is exposed to the water pressure a freshly broken surface of concrete which has not been subjected to troweling or other influences tending to alter the natural condition or distribution of the constituents of the concrete. This freshly broken surface is not only presented to the water on the side to which the pressure is applied, but is also provided on the opposite side where the water leaves the specimen. The test, therefor, is made on a certain thickness of concrete taken from the interior of the specimen and the results are not influenced by the method of finishing these two surfaces.

There are, of course, cases in which it is the surface permeability that it is desired to test and in such cases this form of specimen is unsuitable. But in all cases in which the watertightness of the concrete mass is to be determined the above type of specimen is much to be preferred.

There are also variations of this form of test piece which will accomplish the same result. Any method which removes the finished surface from the area to be tested is to be preferred to one which does not remove that surface.

Even in such cases as those in which the specimen is molded on a surface of glass or other smooth material and no troweling is done, there is a concentration of cement and fine aggregates next to the surface which must affect the results obtained if this richer layer or skin is not removed before test.

Seventh: The curing or aging of the specimen: This matter should also be decided with a view to conditions which will prevail in the field when the real work is done. If it is impracticable on the job to keep the concrete constantly wet for a considerable period, then the test specimens should not be stored in water. If the only wetting the work in the field is to receive is from the water contained in the concrete when it is placed, then the test pieces should receive no additional water after molding. On the other hand, they should not be allowed to dry out any faster than would the work in the field, as they would doubtless do owing to their comparatively small size if kept indoors in a laboratory and no precautions taken to regulate the drying process.

The specimens have now reached the stage when they are ready for whatever tests are to be applied to them and the methods used in performing these tests are so varied that the limited scope of this paper will not permit an extended discussion of them. Those with which the writer is familiar appear to be open to little, if any, criticism. One of the most important features is that the conditions adopted shall remain constant throughout the test.

If the test is an absorption or a non-pressure test, the immersion or partial immersion should be under uniform conditions and for definite lengths of time in clean water. If the test is a pressure test, the pressure should be kept constant, the water clean, and the method of measuring the water passing through the concrete accurate. As the area subjected to pressure is usually small, the amount of water passing is correspondingly small and in some cases where the measurement of the water is made by collecting the drippings from the under side of the test piece the element of evaporation may greatly affect the results. A form of apparatus in which the amount of water passing into the specimen is determined eliminates this error.

Pressure Test Equipment

In this form of apparatus the specimen is clamped and sealed to a metal cap which is provided with a projecting vertical graduated glass tube. The cap and the tube are filled with water and air pressure is then applied to the top of the tube in any desired amount. As soon as the specimen has become saturated and water begins to flow from its exposed face, a reading is taken of the water in a graduated glass tube and thereafter readings are taken at regular intervals of time throughout the period of the test. If it is necessary to introduce more water into the system when testing porous concretes, this may be done by opening an inlet which is supplied with water at a pressure higher than that of the air in the tube and so filling the glass tube again up to the zero mark.

By this method accurate determinations may be made of the amount of water forced into a concrete which is so nearly waterproof that all, or a great part, of the water which passes through it would be evaporated from the exposed surface.

Permanence of Waterproofing Materials

Another matter in connection with tests of waterproofings for concrete which seems to have had but little attention paid to it is the effect of time and the elements upon efficiency of the waterproofing materials. In practically all of the numerous tests of waterproofings made in the past 7 or 8 years in the laboratory of Westinghouse, Church, Kerr & Co., it has been the custom to expose the test pieces to the action of the weather on the roof of their office building, after first testing them, and then testing again after 6 or 12 months' exposure. The results of these tests after prolonged exposure show that few, if any, of the materials which are applied to the surface of concrete to waterproof it after it is made, will retain even a fair proportion of their efficiency. In the case of those methods by means of which the entire mass of the concrete is designed to be waterproof there is shown sometimes a steady improvement after exposure and sometimes a marked decline. In some cases the life of the treatment is very short and the failure after a few months' exposure almost complete.

It is important, therefore, before any particular method of waterproofing be adopted, that the probable life of the treatment be ascertained. It is pretty well established that a good concrete without foreign substances in it improves with age, becomes more dense and water-tight, but the same cannot be said so positively of a concrete containing some of the recently developed compounds intended for waterproofing.

BESSER SIMPLIFIED MIXERS

Besser Simplified Mixers are especially designed to overcome the faults present with many devices and to secure all the possible advantage from the Continuous Method of mixing concrete without the disadvantages that have sometimes been present.

All operations are continuous, but can be instantly stopped or started at will, and these Mixers can be operated at any capacity up to their maximum. If the hoppers are kept full, the machine does the rest, automatically and continuously measuring, proportioning, mixing, wetting and discharging without the intervention of human hands.

This is one of the largest exclusive advantages which we offer. A cement worker, of all men, has no time to tinker with his machinery, and every bearing, gear, sprocket or other part which can be done away with means a decided saving in upkeep and repair. The construction of Besser Mixers in this respect is revolutionary and cannot be overvalued writes the Besser Mfg. Co., 407 Thirteenth Street, Alpena, Mich.

The Besser Simplified Continuous Mixers on skids for belt power have not got a single gear, sprocket, chain or spring and have only the pulley direct on the main Mixer shaft. They have but two bearings in which shafts revolve.

The Besser Mixers on trucks for portable use have no gears or countershafts, and but one chain, viz:—the direct drive from the engine to the main mixer shaft, which carries the mixing paddles.

The BESSER is the only proportioning mixer with such amazing simplicity. The rest all have a jumble of numerous gears, sprockets, chains, miscellaneous bearings, and countershafts, which are bound to require replacement and repair, and cause breakdowns occasionally and semi-occasionally.

Can you afford for a minute to even consider buying an ordinary Mixer with a dozen or more of the above extra wearing parts, which are rendered unnecessary by the Besser Method of simplified construction?

Kindly re-read the above lines until you fully understand their import and appreciate the ease and small expense of keeping these improved and simplified Besser Mixers in operation, with their amazingly small number of parts and entire absence of complicated gearing which is present on all other devices.

Add to the above advantages of wonderful simplicity the following advantages of construction: accuracy of proportioning and measuring, thoroughness of mixing and convenience of control, and a combination is produced which you will agree has no equal on the market, and makes the choosing of a Mixer an easy matter.

We call your attention to the common sense Besser arrangement of hoppers and feed, and the method of measuring and proportioning the materials, which are unique in their reliability and accuracy. This arrangement has been tested out by years of severe use on all kinds of materials in all parts of the country. Many of the half-perfect devices now used by others have been discarded by us years ago, and we point with special pride to the perfection of this all-important detail.

BESSER MIXER.

All hoppers are made of heavy steel and are unbreakable.

The measuring is done by the back and forth movement of the feed plate beneath the hoppers. At every backward movement of this feed plate, the back of the hopper positively forces a certain amount of material from the plate into the mixing trough below, and this amount can be instantly varied by changing either the length of the stroke or the height of the opening. In this way any desired capacity and any proportion can be secured and the capacity can be changed without affecting the proportions. No blocking out and no changing of sprockets or anything of that kind to change the proportions—merely instant adjustment of the gates. Send today for catalog and prices. The Besser Mfg. Co., 407 Thirteenth Street, Alpena, Mich.

HENDRICK'S COMMERCIAL REGISTER

The twenty-second anuual Revised Edition of Hendrick's Commercial Register of the United States for Buyers and Sellers has just been issued. Established in 1891. It has been published annually since that time and is the most complete work of its kind in existence. Its aim is to furnish complete classified lists of manufacturers for the benefit of those who want to buy as well as for those who have something to sell. It covers very completely the architectural, engineering, electrical, mechanical, railroad, mining, manufacturers and kindred trades and professions, it

is as necessary in the office as the rating book, typewriter or telephone. It establishes a direct link between the buyer and seller. The present is by far the most complete edition of this work so far published. The twenty-first edition required 122 pages to index its contents, while the twenty-second edition requires 138 pages, or 16 additional pages. As there are upwards of 400 classifications on each page, the 16 additional pages represent the manufacturers of over 6,000 articles, none of which have appeared in any previous edition. The total number of classifications in our book is over 55,000, each representing the manufacturers or dealers of some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. The twenty-first edition numbered 1,546 pages, while the twenty-second edition numbers 1,635 or 89 additional pages. Add to the latter about 348 pages of cancellations, errors, etc., omitted from the present edition, and you have a total of 437 pages of new matter, the whole representing upwards of 390,000 names and addresses. An important feature of our Commercial Register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. As an illustration—we first classify all manufacturers of a particular trade under a general heading for mailing purposes, we then sub-divide each firm or corporation under as many classifications as every variety of their products call for. By this system of compiling, our book is made of equal value for either the purchasing or sales departments. No other publication embodies these features.

Again, the value of our Commercial Register for purchasing purposes is not confined to its complete classifications alone, it also gives much information following the names of thousands of firms that is of great assistance to the buyer and saves the expense of writing to a number of firms for the particular article required. This latter information is also not found in any other similar publication. We also include the trade names of all articles classified in our book as far as they can be secured. These trade names appear in parentheses between the names and addresses under the classifications where they appear. The book is revised, improved and issued annually. It is expressed to any part of the country on receipt of ten dollars.

S. E. HENDRICKS CO., Publishers,
74 Lafayette Street, New York.

COAL CRUSHER AND SAMPLER

The Sturtevant Mill Company, Boston, Mass., has recently put on the market an automatic coal crusher and sampler.

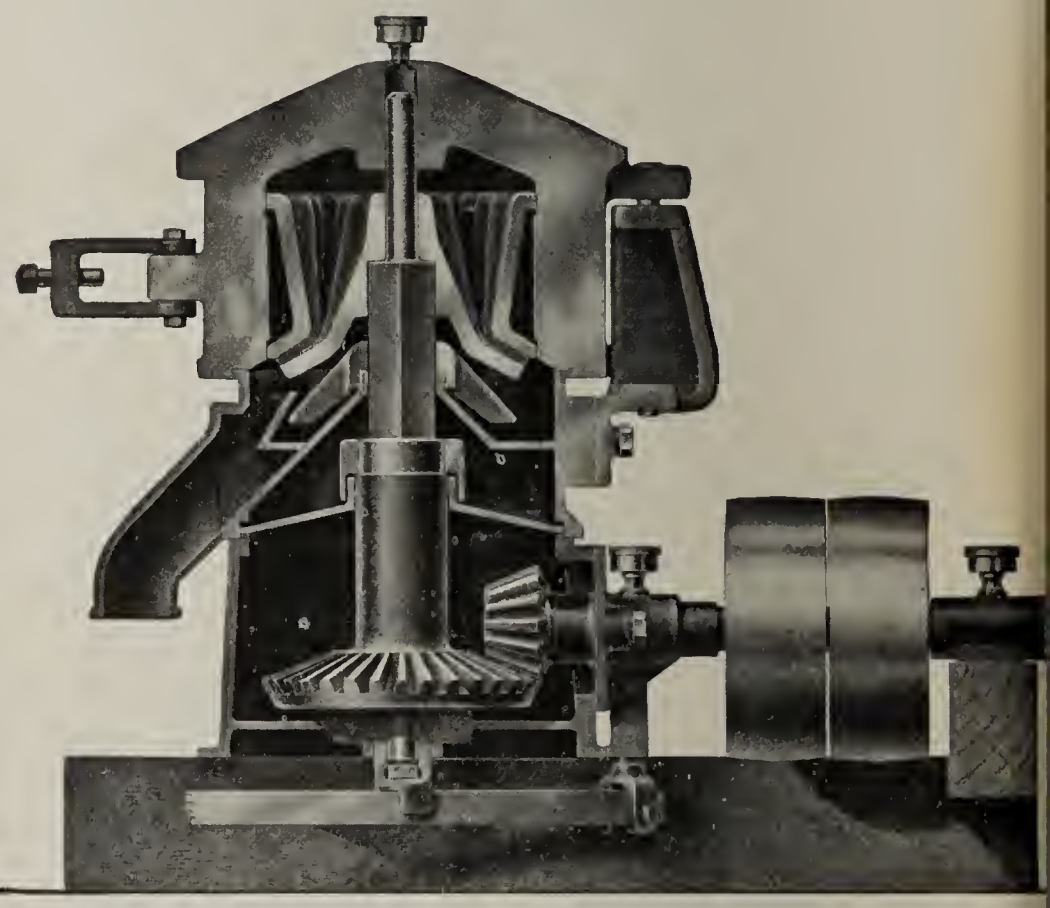
Buying coal by analysis is a growing practice. Coal users should know what they are purchasing, and coal miners should know what they are supplying. All government coal contracts are placed on a B. T. U. basis. Many large public service as well as industrial corporations make their purchases by analysis.

Heretofore, coal sampling has been a long tedious operation, as all the crushing and quartering has been done by hand, and the result has been most unsatisfactory, for a large sample is necessary to give a representative result. Working this down by hand methods in many stages is impractical.

Now, however, a machine is offered which automatically crushes and samples the coal in one operation, in large or small quantities, and what has heretofore required hours or days to perform by hand methods is now reduced to minutes, and any coal miner

or user can with little expense know just what he is selling or buying, and soon save the cost of the machine.

This machine, in its main feature, is no experiment, for the company has built rotary fine crushers for years. This coal crusher and sampler is the same machine as heretofore, with the addition of the automatic sampler attachment.



STURTEVANT AUTOMATIC COAL CRUSHER AND SAMPLER.

Easton, Pa., Sept. 7.—The largest blast ever fired in this region was touched off with an electric spark this afternoon in No. 4 quarry of the Alpha Portland Cement Company, at Martins creek, eight miles above this city. There were thirty-seven holes, sixty-four feet deep and six inches in diameter, in which eleven tons of dynamite had been placed. One hundred and twenty-five thousand tons of rock were torn out, most of it broken into fragments small enough to be handled with steam-shovels.

REINFORCED CONCRETE SEWER

The sewer shown on this page was constructed in Paris, Ill., by Mr. Frank Payne, C. E., of Danville, Ill. Two sizes of sewer were built, the inside diameters being three feet and five feet.

SEWER AT PARIS, ILL. FRANK PAYNE, C. E. REINFORCED WITH NORTH WESTERN EXPANDED METAL.

The five foot sewer has a wall six inches thick and was reinforced in the upper half with No. 30-3 Expanded Metal placed with the long dimension of the mesh running lengthwise of the sewer. The bottom was reinforced with three, one-half inch round rods running longitudinally and placed at the critical points.

The three foot sewer has a wall four inches thick and is reinforced in the same manner as the five foot except that No. 20-3 Expanded Metal was used in the top half and two, one-half inch rods in the bottom.

Collapsible steel forms, manufactured by Besser Manufacturing Company, 407 Thirteenth street, Alpena, Mich., were used and the invert was poured first. Forms were then placed for the crown and the Expanded Metal placed in the forms and the concrete poured.

It gets its long life from the rubber tree

The rubber tree, as every reader knows, is exceedingly long of life. This quality of long life is literally drawn from the rubber tree and transferred to

LONGLIFE CONVEYOR BELT

are built up of a special hard, close woven duck, the plies of which are bound together with friction of a very high grade rubber. Upon this strong and durable backing is placed a coat or cover of wear-resisting, long-lived rubber. That's why Longlife Conveyor Belts

Handle more tons per dollar cost, than any other belt made

Longlife Conveyor Belts are used by such concerns as Universal Portland Cement Co., Atlas Portland Cement Co., Ash Grove Lime & Portland Cement Co., Peninsular Portland Cement Co., and California Portland Cement Co.

Write us for list of Longlife users in your own line of business with all the facts concerning the kind of service they are getting.

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Factories: Akron, Ohio
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There is nothing in Goodrich Advertising that isn't in Goodrich Goods

LIME PLANT FOR OPERATION

The Kentucky Portland Cement and Coal Company, located at Pine Hill, Ky., has been completed and hydrated lime is now being manufactured.

It is stated that the plant of this company is unexcelled in point of construction, modern machinery and appliances with which to manufacture the best possible hydrated lime the market affords, and with the excellent railroad facilities at their command; they are prepared to make prompt shipments at all times, of the products manufactured, which consist of hydrated lime, lump lime, crushed lime and ground limestone.

The coal mine is also in operation and Pine Hill domestic coal of an excellent quality, is now being shipped to the trade.

CEMENT COMPANY WANTS PERMIT TO SELL BONDS

The Orfino Portland Cement Company of Spokane, Wash., has applied to the state railway commission of Nebraska for permission to sell $150,000 in gold bonds to such citizens of the state as care to purchase. The bonds are said to be backed by first mortgages on the assets of the company. The officers of the company, with the exception of T. J. Kastle of North Bend, Nebraska are all out-of-the-state men, says the Omaha Bee.

BRADLEY THREE ROLL MILLS AND GIANT GRIFFIN MILL

The Bradley Pulverizer Company, Boston, Mass., has just received an order from the Riverside Portland Cement Company, Riverside, Calif., for a Giant Griffin Mill installation for the clinker end.

Two 66-inch Bradley Three Roll Mills manufactured by the Bradley Pulverizer Company are being installed in the new plant of the Old Mission Portland Cement Company at San Juan, California, for the reducing end of the mill.

THE ST. LOUIS PORTLAND CEMENT COMPANY'S MODEL 100 MARION SHOVEL, BUILT BY MARION STEAM SHOVEL CO., MARION, OHIO.

A LARGE STEAM SHOVEL IS USED AT THE QUARRY OF THE ST. LOUIS PORTLAND CEMENT COMPANY'S PLANT FOR LOADING THE BLASTED ROCK IN DUMP CARS.

VIEWS AT THE PLANT OF THE ST. LOUIS PORTLAND CEMENT COMPANY. LOWER CUT SHOWS DINKY LOCOMOTIVE HAULING ROCK TO STONE CRUSHER IN PATENTED DUMP CARS.

CRUSHER BUILDING AND TRACKS AT THE PLANT OF THE ST. LOUIS PORTLAND CEMENT CO. ONE-STORY BUILDING IS THE COMPANY'S OFFICE AND STORE ROOM.

A New Car Unloader!

Contractors and those who have to unload open railroad cars should write today for illustrations and prices on the new Link Belt Gondola Car Unloader.

Built either movable or stationary, this Link Belt Unloader will unload stone, gravel, sand, coal, etc., at the rate of 50 tons per hour. Does the work of 8 to 10 shovelers. In successful daily operation by large contractors. Low cost.

If you unload material from railroad cars, this Unloader will save you time and money. Write to-day.

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Please send us full particulars regarding the Link Belt Gondola Car Unloader. We handle_____ cars of_____ every_____

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*Address*_____ *City and State*_____

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THE CONSTRUCTION ENGINEER IS THE ONE MAN WHO

actually rubs shoulders with the Building Material Problem. Talk it over with him. He will be eloquent on the necessity of using a waterproofing compound which

1--Is Not Hard or Expensive to Mix
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3--Permeates Uniformly Throughout
4--Is Disintegration Proof
5--And is sure to be **Hydrostatic Pressure** Proof

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Among The Cement Mills

CEMENT RATES

One of the most important cases that ever came before the Public Utilities Commission was heard this week. It was brought by L. T. Sunderland in behalf of the Ash Grove and other cement companies in the Kansas Gas Belt, against the Santa Fe, Rock Island, Union Pacific, and M. K. & T. Railways to secure a readjustment of the freight rates on cement from Kansas cement mills to practically all stations in Kansas, says the Wichita, Kans. Beacon.

For several years the cement industry of Kansas has been declining rapidly, while in all other cement producing districts in the United States the production of cement has increased materially each succeeding year.

In 1880, 40,000 barrels of cement were produced in the United States and the price was $3 per barrel. The production increased at a phenomenal rate and in 1912 it reached 82,500,000 barrels, and the average price had declined to $0.81 per barrel. In 1910 the production in Kansas was nearly 6,000,000 barrels and Kansas was then third state in matter of production, while in 1912 Kansas dropped to tenth place with a production of only 3,000,000 barrels.

Favor Sugar Creek Mills.

The complainants contended that the attitude of the railroads in circumscribing and restricting their territory by unjust and discriminatory freight rates has been largely responsible for the failure of a number of the companies, and the astounding decline in the total production of cement in Kansas.

Their tables showed that the Kansas railroads have extended to Sugar Creek, Mo., high discriminatory and referential rates, and that Kansas mills are not permitted to do business in Kansas on an equality with the Sugar Creek, Mo., mill, although the mileage and cost of service from the Kansas mills is materially less than from Sugar Creek, Mo.

Better Terminal Rates.

The Kansas cement companies are also seeking lower rates to terminal points like Kansas City, Leavenworth, and Atchison, Kan. For many years the Santa Fe has maintained a 4 cent rate on cement from Sugar Creek to St. Joseph, a distance of 107 miles, while from Iola to Kansas City, a distance of 107 miles, the rate is 7½ cents. The Union Pacific and Santa Fe have only recently joined in a 4 cent rate, (involving a haul over two lines, and a bridge charge across the Missouri river) from Bonner Springs to St. Joseph, a distance of 109 miles, but the Kansas direct lines refuse to give the Kansas mills a like rate to Kansas City to permit them to compete with the Sugar Creek mill, which enjoys a rate of 1½ cents to Kansas City.

The Kansas cement companies ask for a 4 cent rate to Kansas City, 4½ cents to Leavenworth, and 5 cents to Atchison, on carloads of 60,000 pounds, distance 106, 122 and 153 miles respectively.

They contended that a difference of one-fourth of a cent a hundred pounds, or a cent a barrel, would deflect to the business, and, therefore, in order to market Kansas cement against Sugar Creek cement the discriminations in freight rates must be removed.

It cost Maryland 47 per cent more to build roads by day labor than by contract, according to a recent report of W. W. Crosby, Chief Engineer of Highways, for that state.

FREIGHT RATE COMPLAINTS

Complaints against the demurrage charges levied by Michigan railroads on cars containing or held up for loading interstate shipments were made by representatives of the Michigan Association of Manufacturers at a hearing conducted by Special Examiner Pugh of the interstate commerce commission in the United States district court Wednesday, says the Detroit Free Press.

Attorney Hal H. Smith, who appeared for the manufacturers, argued that the time allowed free of charge, for loading cars with interstate shipments should be the same as the time allowed on cars being loaded with shipments for points within the state. The same argument was applied to the unloading of cars coming from points outside of the state.

The Newaygo Cement Company, of Newaygo, Mich., asked that the railroads be forced to grant it a through rate to points in Wisconsin. At present the company is compelled to pay a series of local rates on all shipments of products to Wisconsin points. One rate is charged to Cheyboygan, Mich. Another is charged for ferrying the cement across Lake Michigan to Milwaukee, and a third is charged for transporting the shipment from Milwaukee to the point of final destination. It was stated that six Michigan cement plants have been thrown into bankruptcy by the high freight rates.

The testimony in both cases will be taken to Washington by Examiner Pugh and laid before the interstate commerce commission.

Van Duzen Concrete Mixer

Price $165.00

This is a **ONE-SIXTH** yard mixer. Two wheel-barrow loads per mix. Daily capacity **50 YARDS.** Mounted complete with **2½ H. P. Engine.**

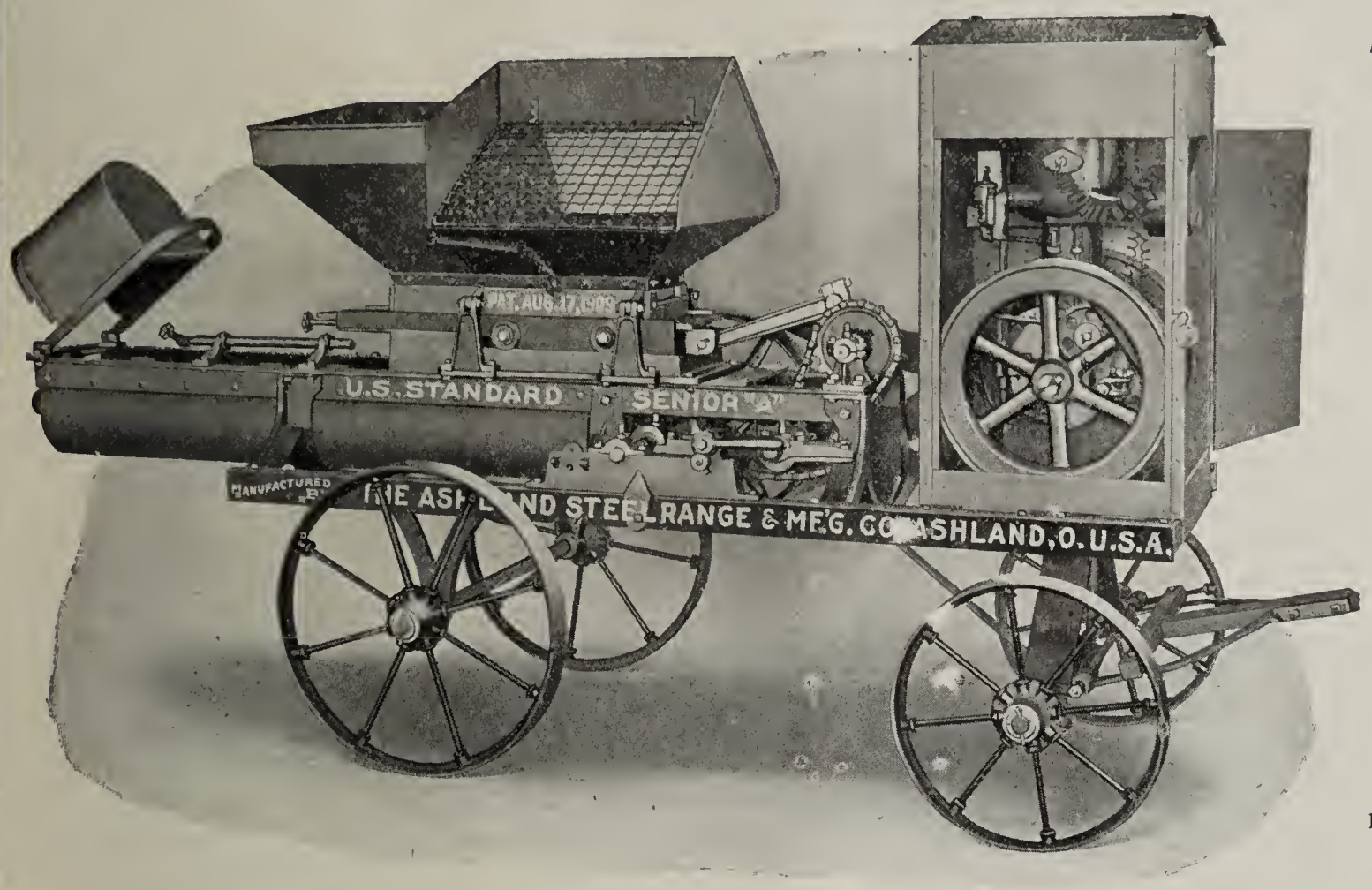
Manufactured under basic U. S. letters patent No. 782,700. BE CAUTIOUS, you are protected when you buy a Van Duzen.

Concrete Mixers, Gasoline Engines, Pumps, Hoists, Etc.

Van Duzen, Roys & Co.,

341 Dublin Avenue, Columbus, Ohio

U. S. STANDARD CONCRETE MIXER



THE SENIOR "A"

Is Accurate in Proportioning the Materials.

Mixes Dry Before Water Is Supplied Giving Thorough mixed, Uniform Product.

Capacity 7½ Yards Per Hour. Other Sizes in Stock at all Times.

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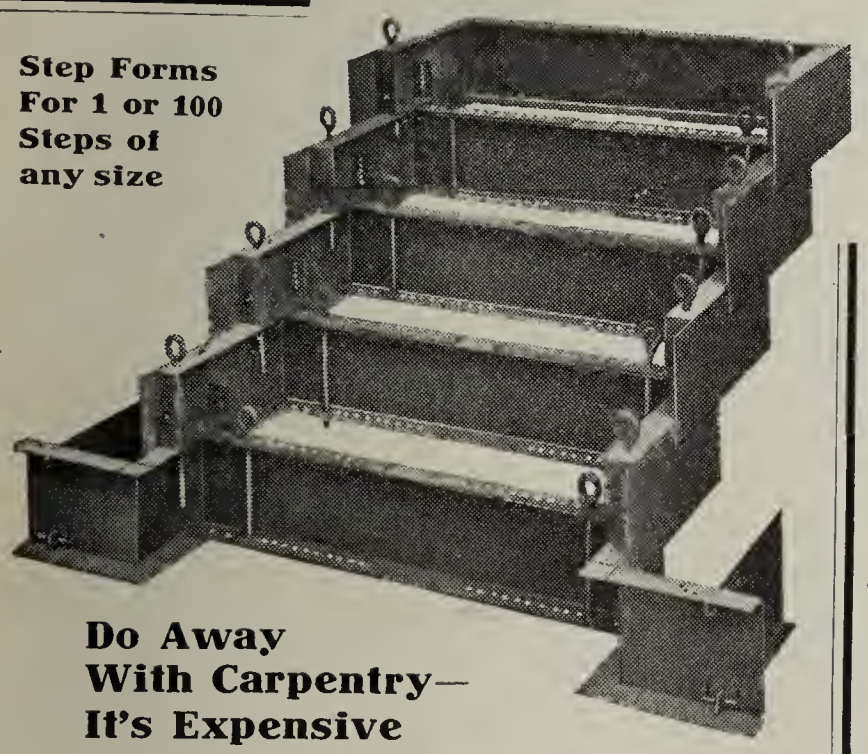

Do Away With Carpentry— It's Expensive

You can't afford to waste time on wooden forms if you expect to do your share of concrete step construction this season. No two sets of steps are alike in dimensions, and to build new forms for each job, it would require a big share of your time and profits. Before the season sets in, better look into the merits of the

Indiana Adjustable Step Molds

Adjustable to all sizes, enabling you to use the same forms on hundreds of different sized jobs. They are complete in themselves, not simply form holders, but a complete set of molds for molding concrete steps.

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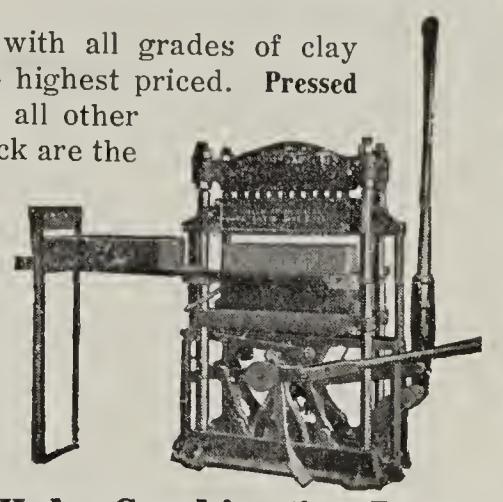

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CONCRETE FOR SERVICE AS WELL AS LOOKS

Barney Bricher believes thoroughly in concrete and his farm of 100 acres, five miles west of Geneva, Ill., is a splendid example of modern construction. The latest addition to his plant is a monolithic concrete silo.

There is one way to permanently increase the value of farm improvements. If built of wood their cost disappears in a few years, if the farm is sold, for tumble-down buildings represent little to the careful buyer. But concrete improvements are practically as lasting as the soil and represent a dollar in the selling price of property for every dollar invested.

Reinforced concrete silo and water tower built for Brookline Stock Farm Co., Aurora, Ill., Wm. George Owner. Capacity of silo, 360 tons. Capacity of tank, 18,500 gal. Total height, 79 feet. It was built by W. H. Warford, Contractor, Geneva, Ill., with forms made by Polk, Genung, Polk Co., of Fort Branch, Ind.

Barney Bricher raises corn, oats, hay and a little barley with a legume catch crop for the good of the soil. But being in the center of the richest dairy region in the world, he is turning toward dairying as the greatest source of profit. He now has thirty-two head of cattle and will increase his herd with the completion of his silo. He has twenty-five pigs so far this year and several more litters coming.

Kane county contains over 100,000 people. There are Batavia, Geneva, Aurora, Elgin and St. Charles, whose population consumes far more farm products than can possibly be raised in the county. Prices are, therefore, good. The price of hay is determined by the cost in Chicago, fifty miles distant, plus the freight from Chicago. Other products are priced in proportion.

While there are a few farms in the county which are run more for the pleasure of their owners than for actual profits, yet the farm of Mr. Bricher is entirely a money-making proposition. Mr. Bricher and his two sons are taking full advantage of the excellent markets afforded by the surrounding towns but are not making a show place of their farm at unwarranted cost.

Early in June the writer visited Mr. Bricher while he and his two sons were at work on the silo. It is being built by W. H. Warford, a contractor of Geneva, but Mr. Bricher and his sons are doing most of the work. Mr. Warford also built the big silo and water tank on the Brookline Farm, which is illustrated herewith, and which is the tallest concrete silo ever built. The country is fairly dotted with other silos that he has put up and he is a well-known man in Kane county.

Mr. Bricher's silo is to be 16 feet in diameter and 45 feet high with 6-inch walls and a concrete roof. It is built with forms of the Polk Genung Polk Co., of Fort Branch, Ind., and promises to be every bit as good as the Brookline Farm silo, except in size. On the one side will be a ladder of iron and on the other side a chute with a generous sized feed room below. Generally silos are placed close to the barn, but this is about 15 feet away; but the feed room opens on a concrete floored barnyard so that it will be very easy to pull a sort of silage from the feed room across the floor and into the barn.

Mr. Bricher is an experienced concrete worker himself. His barn foundation is of concrete, 1 foot thick, forming the walls of the stable. The barn has a concrete floor throughout, molded into mangers and gutters so that it can be kept clean. It cost the owner a little more to build the walls with concrete, but gravel was handy and there will be no rotting of timbers and siding at the ground level. The barn stands on a hillside so that the ground is much higher on the north. The banking up of the earth on the north side has made the stable warm and is, therefore, an advantage.

Mr. Bricher does not believe in feeding hogs in a muddy lot. Corn is fed on a concrete floor 6 inches thick and 16 feet square, at one end of the hog lot. Not a bushel of corn is lost in a year on this floor, and it is small enough so that it is little trouble to clean it.

A concrete floored barnyard makes a great saving of labor. The cows do not bring in mud from the barnyard. When the picture on this page was taken Mr. Bricher and his sons had been so busy building the silo and doing other construction work that the floor was rather dirty, but it is usually kept clean.

On the north it was necessary to build a retaining wall two feet above the floor level to keep back the earth. A fence of boards above the concrete wall and other buildings break the north wind so that the cattle can be exercised in the coldest weather.

It generally happens, when a man builds his barns of good materials and keeps them clean, that the farm home will be equally well built and Mr. Bricher's home and the surrounding yard is an attractive spot. Modern farming makes good equipment necessary and makes good living possible.

A couple of carloads of Universal Portland cement have been used in Mr. Bricher's work, but money spent for the best quality of Portland cement is money well invested.

Catalogue No. 900 of the Orenstein-Arthur Koppel Co. contains a complete review of railway equipment, portable railways, industrial railways, narrow gauge sidings, narrow gauge public railways manufactured by the company and in use at thousands of factories in the United States and abroad.

The catalogue illustrates in detail on 80 pages everything imaginable for locomotives, railroad cars, steel dump cars down to turn-tables, switches and rails. Their material is known the world over for its excellent qualities, so that it requires no further comment.

Customers of the Orenstein-Arthur Koppel Co. will welcome this catalogue as a suitable supplement to their former publications and manufacturers unfamiliar with their equipment are advised to send for it in order to become acquainted with the company's products.

CEMENT
... AND ...
ENGINEERING NEWS

SALT RIVER PROJECT—ARIZONA. GRANITE REEF DAM FROM SOUTH SIDE, IN FLOOD SHOWING GATE HOUSE.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, DECEMBER, 1913

THE CHICAGO CEMENT SHOW.

With about three months left before the opening night of the Cement Show on February 12, 1914, all but half a dozen spaces have been taken by exhibitors. This remarkable demonstration of co-operation and interest is without precedent. In previous years it has been the custom of some manufacturers to withhold their applications until a month or two before the date of the show. This year the first drawing for space was held July 29, when preliminary allotments were made. The purpose of this early drawing for space was to afford the management more time to devote exclusively to the promotion of the Show and the early disposal of all the space has proven a big aid. The quick response by the manufacturers shows a sound recognition of the value of the exhibition. It was evident from the first that the decision of the Cement Products Exhibition Company, to hold but one Show during the winter, and that at Chicago, carried with it the unqualified support of the trade. The demand for space has been so great that the management has found it possible to exercise some discrimination in alloting space to exhibitors who make displays of special interest and importance to the industry.

The working out of the installation scheme for the coming Show is already under way. A large architectural decorating concern in Chicago have been given the contract for the construction of the principal features of the booths. Instead of the usual arrangement of posts and partitions, large figures and ornamental sign posts will be used with no partition at the back to separate the booths. The sign boards and standards will be cast in plaster according to an ornate design and will support an electric light for each individual booth. It is expected that the absence of high partitions will make for a more attractive exposition. The tendency has been to get away from displays boxed up in stall-like booths. It is intended to carry out a unique scheme of ceiling and wall decorations.

The exhibits at the next Cement Show will be thoroughly representative of all branches of the industry. The most important manufacturers of large concrete mixers, eleven manufacturers of Cement, publishers, makers of small mixer block machines, tile machines, steel molds, steel reinforcing and special appliances of every kind will participate.

The National Conference on Concrete Road Building, to be held in Chicago during the Cement Show, has caused several manufacturers of paving mixers and manufacturers of other road building equipment to go into the Show. The Conference will be attended by road men from all over the United States, to take part in the three days' Conference on the construction of roads and street pavements. Over one hundred thousand state, county and township road officials are to be invited to this Conference.

The unusually large number of associations that will have their annual meetings in Chicago during the Show will bring out a great attendance. President Humphrey of the American Concrete Institute states that the Institute program will be the most interesting of any ever given by the old National Association of Cement Users. The next convention will make the tenth anniversary of this organization and the directors of the institute plan to make suitable recognition of the anniversary introducing some new features at the convention.

Within the last month announcement has been made that the annual convention of the National Builders Supply Association will be held in Chicago during the Cement show. Charles Warner of Wilmington, Del., who is the active President, is directing the work of the Association and outlining the program for the annual convention. The association is the national organization of building material dealers in the country. The conventions are always largely attended and the next meeting promises to be no exception. The problems of the retailer of building materials are to be treated from every standpoint. Other conventions will be those of the Illinois Association of Municipal Contractors, National Association of Sand & Gravel Producers, Interstate Cement Tile Manufacturers Association and the Illinois Lumber and Builders' Supply Dealers' Association. All of these are important and active organizations.

C. C. BISHOP DIES

Mr. C. C. Bishop, vice-president, Oklahoma Portland Cement Company, Ada, Oklahoma, and also for twenty years secretary and treasurer of the Marblehead Lime Company, Chicago, died suddenly, supposedly of heart disease, at the Hotel Majestic, Chicago, last week.

Mr. Bishop was born in 1845 and was a resident of Chicago since 1867. His office was located in the Masonic Temple building, Chicago.

Hard Roads and Permanent Bridges.

Daniel B. Luten, C. E., Indianapolis.

Bridges were once looked upon as luxuries. Hard roads, heavy loads, and high speeds have made them necessities. Ten years ago a bridge was considered merely an engineering structure for carrying traffic across a river. Today we are coming to understand that a permanent bridge must carry the roadway itself across the obstructing stream or ravine. It has not been at all unusual to find brick pavements or macadam roads interrupted by plank floors on bridge structures, and at the same time to find high speed traffic limited by a sign reading, "Five dollars fine for driving faster than a walk on this bridge." The modern bridge must carry the brick or macadam roadway over the river, with no interruption of its continuity and with no limitation of speed. Modern heavy loads and high speeds are demanding good roads, and such roads almost necessarily require permanent bridges when the cost is not prohibitive.

A good road is a road that is hard, smooth, and serviceable at all times. A bad road is a mixture of mud thoroughly stirred by a narrow-tired wagon. The State of Iowa expends $5,000,000 a year in endeavoring to make its bad roads good. This seems a tremendous sum. But Iowa has 100,000 miles of roads. This then is but $50 per mile per year, or at the rate of $1.00 per hundred feet of roadway, about one cent per square yard per year. It may be that some of this money has been wasted. But the solution for good roads in Iowa is **more** money. When the money is provided, a businesslike administration of its expenditure should go with it.

How shall additional money be raised? Not by general taxation for the demand for good roads is not general. The farmer is well satisfied with a road that costs from $2,000 to $5,000 per mile to build and $100 per mile per year to maintain. The automobile owner wants a road that will cost $10,000 to $20,000 per mile to build and $500 per year to maintain. And it is the automobile owner that is clamoring for hard roads; the farmer is not demanding them. If this is a correct statement of conditions in Iowa then it would be wise to tax automobiles $1.00 or $2.00 per horse power and expend the resulting funds on main roads for the benefit of automobile owners, through a state highway commission.

The economics of good roads is a wholly different proposition from that of permanent bridges. There is no such thing as a permanent road. All roads are subject to wear, and although the wear on brick and granite block and concrete may be very slight, nevertheless some provision must be made for their maintenance if they are to be kept in good condition. Hence any estimate of cost of good roads must include provision for continual inspection and repair.

There is, however, such a thing as a permanent bridge, one that requires no inspection, no painting, and no repairs. While it may sometime be difficult to show that a good road is a good investment, since its greatest saving is in time and temper, it is a comparatively easy matter to show that for most locations a permanent bridge is the best investment.

Assume, for example, that a bridge costing $1,000 is to be built, and in order to include interest charges let it be assumed that the county officials borrow the $1,000 on renewable notes at 5 per cent. interest and buy a steel bridge with wooden floor that will last twenty-five years. Let it be refloored at a cost of $100 at intervals of six years and repainted at intervals of eight years at $50. The interest at $50 per year will amount to $1,250; reflooring four times amounts to $400, and repainting twice $100, making a total of $1,750, or $70 per year for the first twenty-five years.

At the end of twenty-five years the bridge will require replacing, and it will be necessary to borrow another $1,000, thus increasing the annual cost by the interest of $50, resulting in $120 per year for the second twenty-five years. The next twenty-five years will call for another increase of $50, making $170 per year for the third twenty-five years and $220 per year for the fourth twenty-five years. So at the end of the century the county will be paying $220 per year for the steel bridge and will be owing $5,000 on notes.

It would obviously have been better policy to have expended 50 per cent. more for a permanent bridge on which the interest charge would be but $75 per year, with no increase either in the annual charge or in the indebtedness. If a sinking fund had been provided to take up the $1,000 at the end of twenty-five years, the comparison would have been even more favorable for the permanent bridge.

A bridge to be absolutely permanent, as required by this comparison, must not only be free from all necessity for inspection and repairs, but it must also provide adequately for all future increase in traffic. Such a bridge is the concrete arch bridge, and it is the only bridge known at the present time that does fully meet these requirements.

Traffic is increasing both in weight and in volume as time passes. The concrete arch bridge increases in strength with time, because it employs concrete principally in compression, and concrete increases in strength in compression approximately 50 per cent. in the year following the first month, and continues to increase slightly for an indefinite period. Since such bridges are designed to take their full loads at thirty days, when centers are ordinarily removed, such increase in strength will provide for almost any ordinary increase in weight of traffic. And since the concrete arch can be widened at any time without loss of the original structure, all future increase in volume of traffic is provided for in such a bridge. New Jersey is now building its state bridges with 24-foot clear roadway, 30-foot preferred; Maryland 24-foot, and California 21-foot. A 16-foot roadway will not long suffice for traffic in any progressive community.

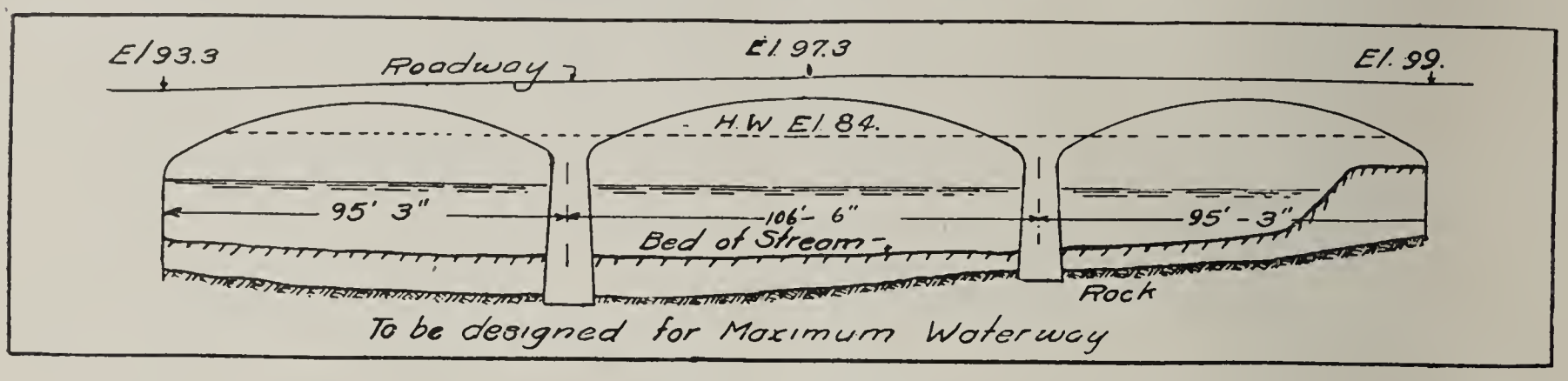
The only other requirement, therefore, is that the bridge shall be made of permanent material, and we have every reason to believe that concrete is such a material. Embedded steel reinforcement is fully protected against rust, and the two materials have practically the same co-efficient of expansion.

The reinforced concrete arch competes in cost with temporary bridges. Ten years ago there were possibly 100 concrete arches in this country. Now there are upwards of 10,000. This popularity is due to the fact that concrete arches have become recognized as the ideal solution of the permanent bridge problem. They are rust-proof and frost-proof, flood-proof and fire-proof. They are built with home labor and ma-

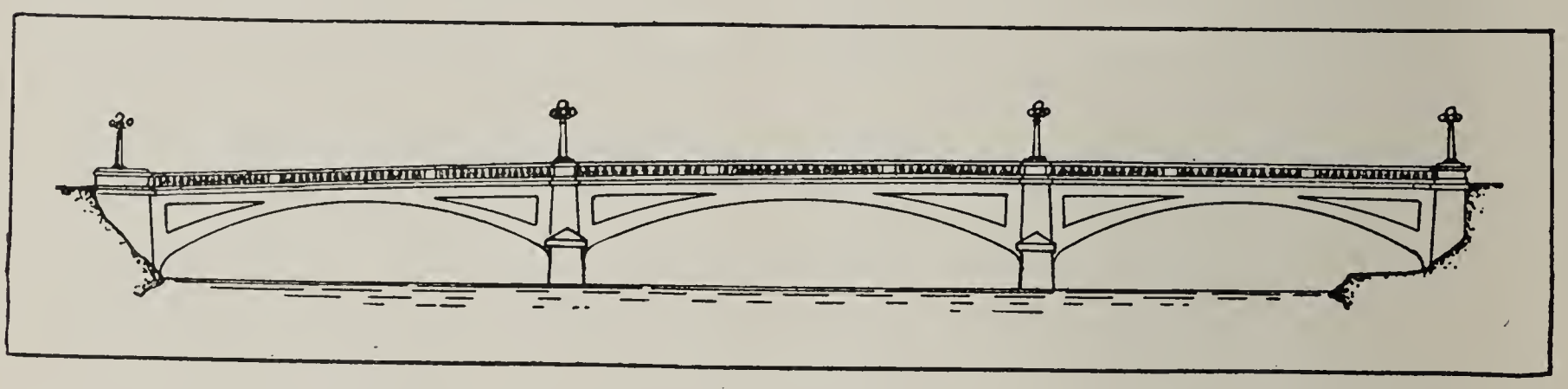
terials and require neither painting nor repairs. An arch bridge, with its wide abutments, is not easily undermined by floods. It makes a desirable bridge even on soft foundations and for restricted waterways.

Concrete bridges have one serious drawback at the present time which should ultimately be an advantage, but in practice now is a serious menace. That is that the building of concrete bridges is wide open to everyone. When engineers become trained in design, and contractors become skilled in estimating and erecting, this will be reckoned one of the advantages of concrete bridges. But under present conditions, the low bidder on a concrete bridge is, in a majority of cases, some unskilled contractor who has unknowingly bid too low in an overzealous attempt to secure the contract. And the contractor who has bid below cost

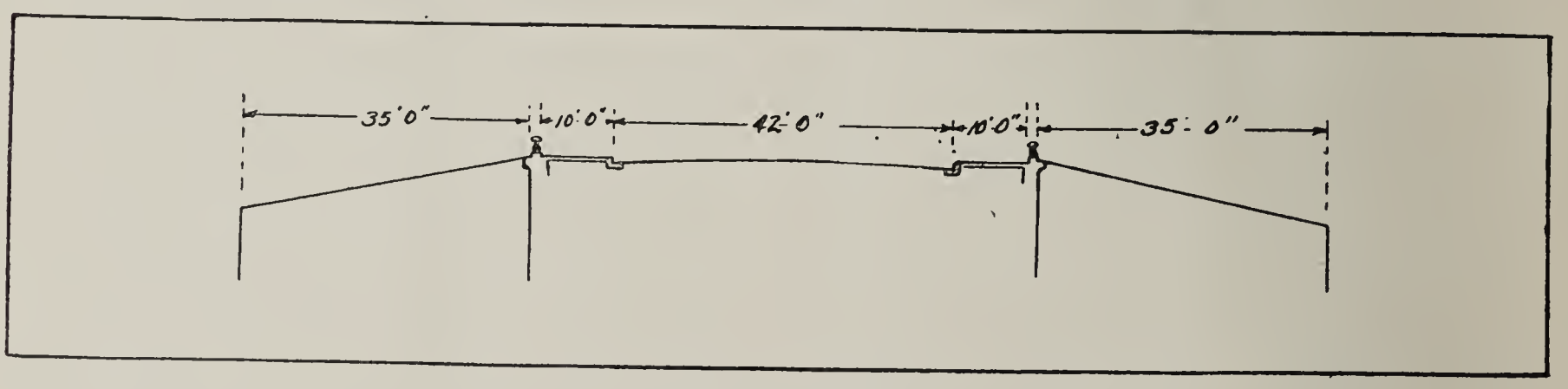
Sample Plans for General Plan Letting.



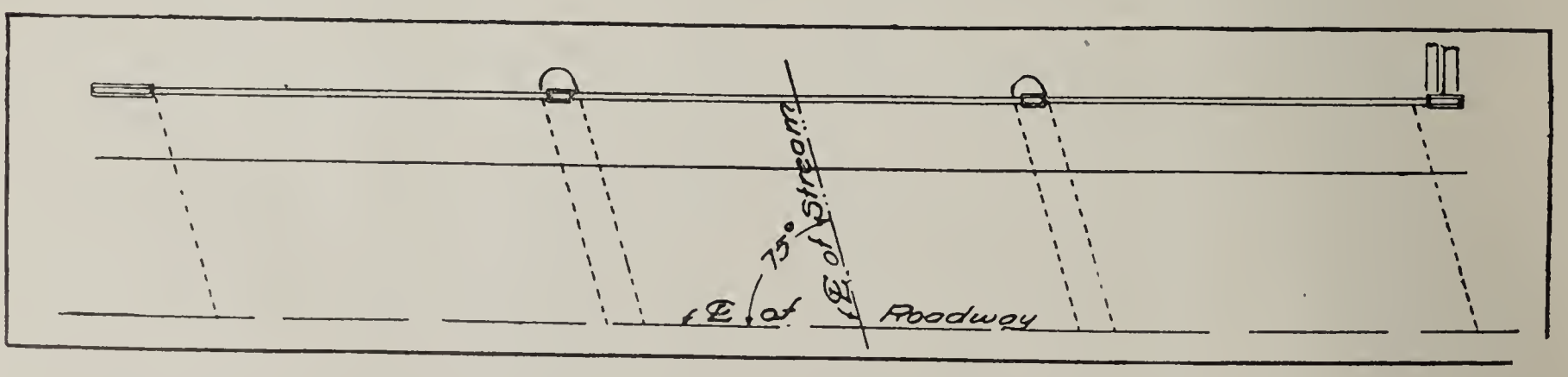
Longitudinal Section



Elevation



Transverse Section



Half Plan

soon loses his enthusiasm, endeavors to skimp his work, delays progress in a mistaken attempt to save cost, and ends finally in bankrupting himself and producing a bridge that is a credit neither to himself nor to the designer.

Education will cure this defect in time. And one of the most important steps towards that end is teaching bidders to estimate costs properly. The prospective bidder too often estimates the yardage in the plans, and then computes his cost at $6.00 or $7.00 per cubic yard, forgetting that in the majority of cases $10.00 per yard is too low, and even $25.00 may not be enough to pay the cost in some exceptional cases. The only safe way is to estimate each of the many items that go to make up a concrete bridge, as shown in the accompanying estimating sheet, for a reinforced concrete bridge.

Estimating Sheet

Right of Way			$.....
Temporary Bridge			.....
Removal of Old Bridge			.....
Excavation, Dry	.....Cu. Yds.	@.....	.....
Wet	.....Cu. Yds.	@.....	.....
Cofferdams, Lumber	.....Bd. Ft.	@.....	.....
Labor			.....
Sheeting Embankments, Lumber	..Bd. Ft.	@.....	.....
Labor			.....
Shoring Buildings, Lumber	.....Br. Ft.	@.....	.....
Labor			.....
Pumping			.....
Foundation Piling, Cost	.....Lin. Ft.	@.....	.....
Driving	.....Lin. Ft.	@.....	.....
Falsework Piling, Cost	.....Lin. Ft.	@.....	.....
Driving	.....Lin. Ft.	@.....	.....
Steel	.....Lbs. f. o. b.	@.....	.....
Hauling			.....
Placing			.....
Lumber for Centers, Forms, Etc.	..Bd. Ft.	@.....	.....
Lumber for Runways, Platforms	.Bd. Ft.	@.....	.....
Hardware, Nails, Etc.			.....
Erection Centers			.....
Erection Forms			.....
Concrete	.....Yds. Labor Mixing		.....
	Labor Placing		.....
Cement	.....Bbls.	@.....	.....
Hauling Cement			.....
Sand delivered	.....Yds.	@.....	.....
Gravel or Stone delivered	..Yds.	@.....	.....
Hauling Water			.....
Sprinkling Concrete			.....
Drains			.....
Waterproofing			.....
Expansion Joints			.....
Filling	.....Yds.	@.....	.....
Paving	.....Sq. Yds.	@.....	.....
Curbs	.....Lin. Ft.	@.....	.....
Sidewalks	.....Sq. Ft.	@.....	.....
Railing	.....Lin. Ft.	@.....	.....
Wiring and Conduits			.....
Lamps			.....
Removal of Centering and Forms			.....
Surface Finish	.....Sq. Ft.	@.....	.....
Superintendence			.....
Bond			.....
Employers' Liability Insurance			.....
Moving Plant			.....
Depreciation of Plant			.....
Contingent for Floods During Construction			.....
Royalty for Patents, Etc.			.....
Office Expenses			.....
Total Cost			.....
Add Profit			.....
Estimated Cost to Owner			.....

Another remedy for bad designing and poor workmanship on concrete bridges is patent protection on cost saving devices whereby expert engineers and builders may be able to secure contracts at a profit even in competition with unskilled contractors, who often bid ten to twenty-five per cent below cost.

Civil engineers particularly have been slow to understand and appreciate the value of patents in developing a new engineering industry. They find it difficult to excuse payment of royalties on patented devices, feeling sometimes perhaps that it is a reflection on their own engineering abilities. Everything depends upon whether the patented devices are worthy and are backed up by efficient engineering services. If so, then the payment of a ten per cent royalty not only is an actual saving to the client but it encourages the payment of higher engineering fees. For while the engineer may sometimes find it difficult to recommend to his clients the employment of a specialist for services that the client thinks should be supplied by the engineer himself, he need never have such hesitancy regarding a properly protected and meritorious patented device. For he can then advise his client that its use can be secured in no other way than by the payment of the established royalty and engineering fee.

The use of any patented device whereby a saving in steel is effected at the same time that the placing of the concrete is cheapened, is a meritorious achievement that may well repay the expenditure for royalty. It is a substitution of brains and good common sense for waste material. The saving of lumber by improved centering design is another feature that has been greatly neglected. In addition to all of this it is quite possible to design one concrete arch that will require twice as much concrete as another design for the same structure, yet with the lighter design possessing twice the strength of the heavier plan. Actual yardage of concrete counts for little in arch design unless efficiently placed. If not skillfully designed the additional concrete obstructs the waterway without increasing the strength and thus lowers the efficiency of the structure.

An effective method of letting concrete arch bridges to secure competition on patented plans is by submitting to the bidder the externals only and requiring each bidder to submit with his bid, not a complete plan, but merely a guaranteed section showing the structural parts of the proposed bridge and conforming to rigid requirements as to stress and bearing pressure. The engineer is then placed in the position of passing upon the sections submitted, to determine whether they conform to the requirements and thus becomes the judge of whether the low bid is a formal one. If not, his recommendation accomplishes its rejection and consideration is given to the next bid.

A complete set of plans such as would be prepared by the engineer in charge of the letting is shown herewith. It should be noted that no structural sections are included; these are to be supplied by the bidder. The bidder does not design complete plans as in submitted plan competitions. Desirable clauses to be included in the specifications and covering the guarantee and stresses are also given below.

Desirable Clauses to be Added to the Usual Specifications.

The accompanying plans, together with the accepted bid and these specifications, form the basis of the contract and are each to be considered a part thereof. The contract contemplates a structure complete in all its details. Each bidder shall file full detailed drawings conforming to all the requirements of these plans and specifications and showing fully all sections, reinforcements, etc., which shall become a part of the contract after approval by the engineer. Such detail drawings shall follow in a general way the architectural treatment of these General Plans. If the general architectural treatment is changed, it should be to obtain a better result rather than to cheapen the structure.

The fixed load is to be considered as consisting of all the filling, pavement, tracks, etc., between the arch and the proposed surface, estimated to weigh 125 pounds per cubic foot, and the concrete of the arch and spandrel at 150 pounds per cubic foot.

The moving load is to be considered as consisting of a uniformly distributed load of 150 pounds per square foot, or a concentrated load of a twenty-ton road roller and a concentrated load of 100-ton cars on two trucks spaced 22 feet on centers, in train and at high speeds, on each proposed track.

The allowable stresses in materials shall not exceed the following intensities:

Compression in concrete	500 lbs. per sq. in.
Tension in concrete not reinforced	0 lbs. per sq. in.
Shear in concrete	50 lbs. per sq. in.
Tension in steel	16,000 lbs. per sq. in.
Compression in steel not restrained	0 lbs. per sq. in.
Compression in restrained steel	ten times the compression in contiguous concrete.

The allowable pressures on foundations shall not exceed the following intensities:

Rock	25 tons per square foot
Hard-pan	10 tons per square foot
Coarse gravel cemented	7 tons per square foot
Clay	3 tons per square foot
Sand confined	2 tons per square foot

The contractor shall examine the proposed location and these plans and specifications, and by submitting a bid on them shall signify his approval of them, and shall guarantee the proposed work for one year from completion against failure on account of any defects of design, workmanship and materials, said guarantee to be secured by a surety company bond equal to the contract, which bond must include a clause specifically setting forth the said guarantee.

The greatest advantage of this method of letting is that it compels the unskilled novice to design a section that he can be legally bound to guarantee before he can compete. In the majority of cases he examines the plans a day or two before the letting and is thus too late to prepare himself for bidding. If he does attempt to prepare his own plan, he will have difficulty in securing a surety company bond guaranteeing its stability. If he goes to a properly qualified engineer for his plans he must needs satisfy him that he can erect the bridge properly. And if he does secure an unsatisfactory plan and does present his surety bond, then there is still the opportunity for the engineer in charge to condemn his plan and thus secure the rejection of his bid on proper grounds. Whereas, when the unskilled contractor bids below cost on a fully detailed plan with a properly certified check or bond no public official dares to reject his bid on the grounds of incompetence. For the taxpayer does not yet realize all of the difficulties that are encountered in the building of a handsome and permanent concrete bridge. For the present, at least, such construction must be limited to experts, if satisfactory results are to be secured.

THE CHICAGO, MILWAUKEE & ST. PAUL RY. USES BULK CEMENT

That the use of bulk cement effects a distinct saving in time and money has been proven by the Chicago, Milwaukee & St. Paul Ry. At the Bloomingdale Road track elevation in Chicago, which will involve a total of 80,000 barrels of Universal Portland cement, R. J. Middleton, assistant engineer in charge of the work, was prevailed upon to try three cars of bulk cement. Before the first car was half emptied Mr. Middlton decided that for work in his charge, cement would be handled in no other way. The success was so great that they are now using 1,500 barrels per week and this quantity will be increased considerably as the work progresses. Since the first car of bulk cement was received they have not called for a single car of sacked cement.

The first four photographs illustrating this article were taken prior to the receipt of the first car of bulk cement. The second four were taken during the use of the first car. The efficiency of the new plan was at once marked.

Fig. 1. Loading sacked cement from car to barrow, three men in car, two men wheeling.

Figure 1 demonstrates the number of times that cement has to be handled when shipped in sacks. Two men were required in the car to place the sacks on a platform, from which three men loaded the barrows and wheeled them to the mixer, where another man untied and emptied them into the chute. The sacks

Fig. 2. Wheeling sacked cement to mixer platform.

were then laid aside and after a sufficient number had accumulated on the platform, counted, bundled and reshipped.

Figure 2 shows the runway and Figure 3 the congested mixing platform with one man about to dump a sack into the hopper. Considerable cement was kept on the platform at all times in order that there would

Fig. 3. Congested conditions at the mixer platform where cement, sand and stone are wheeled along the same runway.

Fig. 4. Dumping concrete into the retaining wall foundations.

be no delay and this handicapped the bringing in of the other materials. Five men were required at all times and sometimes six, to keep the mixer supplied with cement. Figure 4 shows the mixer dumping concrete into the retaining wall foundations.

The same equipment was used later in handling bulk cement. Figure 5 shows the interior of the car, looking toward one end with the shoveler at work filling the wheelbarrow to the height designated by the engineer, so as to contain 2 cubic feet. This was easily accomplished by leveling off a 3-foot barrow even with the top. The photograph was made while cement was being shoveled in the normal manner, proving that there was practically no dust in the car.

Figure 8 shows a laborer wheeling a barrow out of the car door and up the runway to the mixer. Instead of having the cement car beyond the gravel and sand cars it was in this case placed next the mixer, shortening the haul, and actually permitting two men to wheel all the cement where otherwise three men were required. This would have been equally possible with sacked cement.

Figure 6 shows a wheelbarrow load of cement being dumped into the hopper and the entire absence of dust is evident. Nor was there an accumulation of cement on the platform so that the entire space was free for bringing up stone and sand. The operations at the mixing platform were considerably more efficient in the new plan.

The change from sacked to bulk cement eliminated the work of one man on the platform and furthermore eliminated the handling of sacks. There were no sacks to be picked up, counted, bundled and shipped to the mill, nor were there freight charges to be paid which meant a saving of five cents per barrel or $10.00 per car of cement in addition to the saving in labor of two men.

The equipment on the work consists now of a platform or runway sufficient to handle a line of three cars of bulk cement without switching. These are attached to the cars in such a way as to be easily removed but permit 600 barrels of cement to be used at one setting. This is ample for the heaviest day's work. There is no question in the minds of the Chicago, Milwaukee & St. Paul Ry. engineers as to the saving and they are not only using bulk cement for the Bloomingdale Road elevation but will use it shortly in the Milwaukee track elevation work and probably on all construction work where bulk cement can be obtained. They have proven that this progressive means of handling cement far surpasses in every way the old stereotyped method of handling cement in sacks.

The Illinois Improvement & Ballast Co. of Chicago is now using four cars of bulk cement per day on railroad work. The Nash-Dowdle Co. of Chicago are using one car per day in making cement sewer pipe. The Great Lakes Dredge and Dock Co. of Chicago are using considerable bulk cement on dock construction. There is hardly a phase of heavy concrete construction where bulk cement cannot profitably be substituted.

Fig. 6. Dumping bulk cement into mixer hopper. No dust.

NEW CRUSHING PLANT

The Newton County Stone Company of Kentland, Ind.. started operating its crushing plant a few days ago. The quarry is situated on a branch line of the Pennsylvania railroad, three miles east of Kentland.

When the plant is fully completed it will have a No. 5 and a No. 7½ Austin Manufacturing Company crusher, besides a pulverizer.

The entire plant, with the exception of the electric motors and quarry pumps, is equipped with Austin Manufacturing Company machinery. The plant will have a capacity of about 1,500 tons per day, as the stone is very hard and crushes rapidly.

The stone is considered among the best in the state of Indiana for roads, concrete and fluxing, also for land fertilizer. The quarry is being opened up by hand, but a 70-ton steam shovel will be installed early next season.

Every machine on the plant is driven by electricity, there being no boilers or pipes of any kind used. The demand for the products of this quarry is more than the plant can produce.

N. H. Patnoe, who has had some thirty-five years' experience in erecting stone-crushing plants and opening up quarries, and who was connected with Dolese & Shepard of Chicago for seventeen years, has been in full charge of the construction of the plant.

Fig. 5. Interior of a 200-barrel car of bulk cement. No dust.

CRUSHED ROCK AND GRAVEL

The Cedar River Stone and Gravel Company has just completed a new stone crushing plant at Waverly, Iowa, and operation has already begun. John Sims is president and general manager. In addition to marketing crushed stone, the company will also deal in gravel and cement products. On the south side of the river and directly opposite the plant is one of the best gravel pits in this section of the state. To obtain the gravel from this pit a cable will be stretched across the river and the gravel will be conveyed in buckets to the cars.

Fig. 7. Another mixing plant of the C., M. & St. P. Ry., using bulk cement.

FINENESS DETERMINATIONS IN CEMENT

We are pleased to have an opportunity to reply to Mr. Enright's letter, which appeared in the October issue of Cement & Engineering News, as the matter of fineness determination is one to which we have recently paid some attention.

A few months ago a considerable number of sifting tests were made in our cement laboratory primarily to determine what variation in sifting value might be expected with sieves which receive the certificate of this bureau. The results of these tests were deemed of sufficient interest and importance to be published as a technologic paper of this bureau, which is shortly to appear under the title "The Variations in Results of Sifting with Standard Cement Sieves."

In carrying out these tests thirty-four No. 200 sieves were employed, twenty-one of which received the Bureau of Standards certificate. The maximum range obtained in sifting a carefully prepared cement with these sieves may be slightly greater than this value, we believe that a discrepancy of 5 per cent is excessive and indicative either of careless manipulation or of defects in the sieves developed subsequent to inspection by the bureau. This opinion, however, does not alter the fact that verified differences of 2 per cent on "standard" No. 200 sieves are unfortunately large, and we have adopted the practice of determining corrections to the standard sieves used in routine testing, and applying these corrections in fineness determinations.

Fig. 8. Wheeling bulk cement up the runway of the mixer platform. No dust.

It has thus been established, as Mr. Enright points out, that mesh and wire measurements alone are not wholly adequate to determine the sifting values of sieves. In view of this fact the Bureau of Standards has recommended that a tolerance of 1 per cent be permitted in fineness determinations which are made according to the present specifications.

In conclusion it may be noted that the Bureau of Standards has for some time considered the feasibility of issuing a standard cement sample at nominal cost in order that the testing laboratories may check up their own sieves, but owing to pressure of routine and investigative work the matter has not yet been given the attention it deserves.

E. B. Rosa,
Acting Director, Bureau of Standards,
Washington, D. C.

CHIEF CHEMIST

Robert C. Haff of Hudson, N. Y., formerly chemist for the New York & New England Cement and Lime Company, has moved to La Salle, Ill., where he has taken a position with the Marquette Cement Manufacturing Company as chief chemist.

THE EASTON CAR & CONSTRUCTION COMPANY

One of the most interesting announcements of the year in the manufacturing field, is the purchase of all stock, rights, plant, office records, equipment and "good will" of the Ernst-Wiener Company, by the Easton Car & Construction Company, of which Mr. W. E. Farrell is the leading spirit.

While the Easton Car & Construction Company is an entirely new organization, and the change in ownership is complete, the business will be conducted as heretofore; the industrial railway equipment—cars, track and other appurtenances—will bear their old stamp of excellence, and as a first example of a new progressive spirit, the manufacture of plate, tank and structural steel, up to ½-inch in thickness has been added.

The company has a newly erected plant at Easton, Pa., that is completely equipped with new and special machinery, specifically adapted to the fabrication of the well-known Ernst-Wiener line. Everything will be sold hereafter under the trade name of the Easton Car & Construction Company, and with a large stock of their products on hand, the new organization is in a position to effect immediate deliveries. It solicits the continued patronage of former customers and assures others that it is an active bidder in the industrial railway and structural steel markets; all opportunities to bid will be thoroughly appreciated and will be accorded immediate attention.

STEAM SHOVEL CHAIN

The Columbus Chain Company of Columbus, Ohio, are now making what they call their "Hercules Solid Weld" steam shovel chain.

They have spent a great many years of labor and investigation in getting a special iron suitable for steam shovel chain and in training a select number of skillful chainmakers to put it together so it will hold. They have now succeeded in doing this and claim for their "Hercules Chain" that it will actually wear out before the links will separate.

Hercules chain is now used all over the world, having dug a very large part of the Panama Canal, dredged the Harbor of Havana, and used on a number of the large railroad systems of the United States and Canada. Where it has shown the best results, is in stone quarries and rock work where the service required is of the very heaviest and where the chain soon goes to pieces if it is not made right. Some of their Hercules chains are said to have been operated in rock work and run every day for a full year, continuous service, without developing a single broken link. Hercules chain is a little higher in price than other steam shovel chains but the Columbus Chain Company have gone on the principle that an operator buys a steam shovel chain for the service he can get out of it, and that he is willing to pay a fair price for this service.

The Columbus Chain Company issue from time to time a little circular telling about this special chain and giving testimonial letters from leading contractors. They will be glad to send it to any one on request.

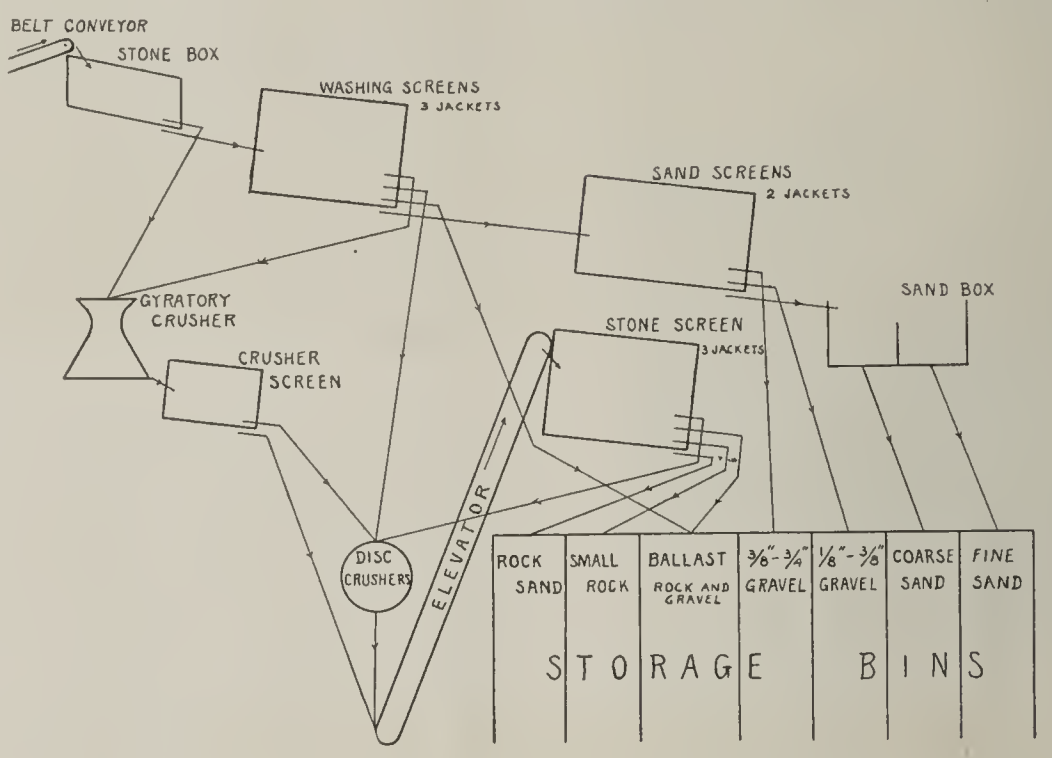
CONCRETE DOCKS

Texas City Transportation Co., and Texas City Terminal Co., Texas City, Tex., are reported as to build four reinforced concrete docks, 1,200 feet long and by 155 feet deep; completion to provide nine fireproof warehouses of 30,000 bales capacity each, and berthing space for twenty-six steamships in addition to present facilities for fourteen ships.

Gravel Washing and Crushing Plant

Concrete Buildings Equipped with Electric Power and Elevated Machinery Delivering by Gravity to Storage Bins

For several years the Norfolk & Western Railroad has taken ballast from a gravel pit about 2,000 feet long, ¼ mile wide and 35 feet deep, which contains approximately 3,500,000 cubic yards. This pit is located on the line of the railroad about 16 miles east of Cincinnati. Increased traffic and double-tracking devices necessitated a larger supply of higher grade ballast material which is to be furnished from this pit by the Ohio Ballast Company of Columbus, Ohio, who contract to wash, crush, screen and deliver it to the railroad company and also to handle the sand which is of good quality for concrete purposes.



"Flow" diagram, showing course of materials through plant.

General Design of Plant

The old pit, parallel with the railroad track, had been excavated to an area with grade and elevation suitable for the location of the plant midway of its length at an elevation of about 25 feet below the level of the main track and with ample room there for storing and loading tracks and convenient to water supply.

The equipment of the plant is similar to that of the Concrete Materials Company, Columbus, Ohio, with gyratory crushers in three units and rotary screens with gravity feed from elevated washers to storage bins over loading track and a capacity of 1,500 cubic yards per 10-hour day. This type was adopted for the ballast plant with a capacity of 2,000 cubic yards per day, of washed material and a storage capacity of 750 yards to handle a maximum of 50 carloads daily.

The sand and gravel are delivered on an elevated standard gauge railroad track to a large reinforced concrete hopper under the track and fed through a reciprocating feeder to an inclined belt conveyor. The conveyor delivers through a dump box and over an inclined grate bar screen at the top of the plant which rejects the larger stones, sending them to the principal crusher and delivering the remainder of the material to a revolving washer screen. The washer delivers rejects to an auxiliary crusher and the balance of the material to revolving stone and sand screens over the elevated storage bins which receive the graded materials and deliver them by gravity to cars on surface tracks under the bins.

Wash water is supplied by a centrifugal pump located on the river bank about 1,000 feet away. The machinery is operated by a single unit 250-hp. electric motor in the adjacent power house, from which power is transmitted by belt. Excepting the belt conveyor and a bucket elevator from the auxiliary crushers, there is no conveying or handling apparatus, all materials moving continuously by gravity.

The principal structure, including the storage bins, supports for screen system, crushers and washer, is of reinforced concrete, using column and arch construction under the bins, columns and beams for the frames supporting the screens and washers, and hollow foundations for the crushers.

Operation

The material receiving track from the pit is carried up at a 3 per cent grade on a fill from a switch at the ladder track in the pit to the top of the hopper walls and is supported over the hopper on two pairs of 15-inch I-beams. The hopper walls are waterproofed and rise 14 feet above grade to carry the track. The hopper floor is 5½ feet below track level.

The 30-inch belt conveyor, about 200 feet long, is inclined about 18° to the horizontal and is carried over Webster Troughing Idlers to a height of 59½ feet above track level. It discharges the run of the pit into a 6 x 12-foot steel dump-box where a fan-shape nozzle on a 6-inch pipe discharges a wide thin jet of water which washes the material. This dump-box is inclined 1:4 and discharges over a grate bar screen to a 4-foot x 11½-foot rotary wash screen with two jackets which is mounted on trunnions and rollers.

Crushing

The wash screen passes everything up to 2 inches and rejects are carried by a steel chute to a No. 7½ Type K Gates Crusher made by Allis-Chalmers Mfg. Co., Milwaukee, Wis., 30 feet above the tracks, mounted on a hollow concrete foundation. The two jackets on the wash screen separate the sand from the ballast and deliver both through watertight steel

chutes to the sand box, sand screens and stone screens, located over the storage bins.

Sand Grading

All sand from the washer screens is delivered to a 6 x 13-feet sand box 2½ feet deep having in the bottom two conical steel hoppers with their lower ends closed by cone valves operating from above by a rising stem and hand wheel. The coarse sand settles in the cone nearest the inlet of the box and the fine sand settles in the cone nearest the outlet for waste water, thus effecting a distinct grading of the sand. The water escapes over a weir and through a flume to the waste beds.

screenings from the intermediate screens and the product of the Symons Crushers are delivered by the bucket elevator to a four-jacket rotary trunnion-mounted stone screen gear-driven from an overhead shaft. The stone is thus graded and the different sizes are stored in separate bins as required.

The storage bins discharge through under-cut gate opened and closed by rag wheels and crane chains actuating pinion and spur segments operated from the car or from the ground.

WEBSTER BELT CONVEYOR FROM TRACK HOPPER TO PLANT.

Reinforced Concrete Construction

The 18x36-in. columns supporting the storage bins are reinforced with 1¼-in. twisted wire bars with ¼-in. wire steel hoops 12 in. apart. The exterior walls of the bins start below the bin floors and on the bin tier side are supported on five-centered arches. There are ten 10x14-ft. 75-yd. bins in two rows, separated by dividing wall 2 ft. thick with two arched openings below the bin bottoms. The bin floors are carried on second hand 12-in. I-beams and consist of concrete arches with a 6-in.

WHERE THE BELT IS LOADED BY AN APRON FEEDER.

Ballast Screening

The stone screen rejects gravel larger than 1½ inch, which is shunted to a hopper discharging into either of two Symons Disk Crushers that deliver to a bucket elevator returning the product to the screen. The Gates Crusher discharges to a 4 x 8 ft. one-shell intermediate screen, which passes 1 in. and smaller material and delivers the rejects to the Symons Crushers. The

rise and 28-in. span on a centering of No. 10 expanded metal with 3-in. mesh sprung between the I-beam flanges that are covered with 1 in. of concrete protection. The floor has an average thickness of 15 in. and is provided in the center of each bin with an 18 x 18-in. opening for the steel discharge chute.

The 15-in. bin partitions and the 18-in. outer walls are reinforced with No. 10 expanded metal 3-in. mesh throughout their entire height and with 5/8-in. twisted bars 8 in. apart in the lower third of their height.

The sand and stone screens, sand box, sand cones and distributing troughs are carried by 12-in. I-beams supported on the bin walls. The reinforced concrete beams and girders for the washer, wash screen, dump-box, and transmission machinery are framed into the concrete bins. They form a frame work 40 ft. high above track level with 18 x 36-in. columns rising to a height of 28 ft. above grade. The walls are carried on five-centered arches. Stair landings and working platforms and the main upper floor are carried on 12-in. I-beams. The superstructure above the storage bin is a timber frame work covered with galvanized corrugated iron. The 12 x 12-in. timber posts and framing supporting the trusses and roof were arranged to take bearings for the transmission machinery. The trusses were proportioned to support a 5-ton chain

Crusher screens.

Water Supply

block runway for placing and repairing the Gates

Washing water is drawn from a concrete pump well on the east bank of the Little Miami River, about 1,000 feet north of the plant, by an electrically driven centrifugal pump. The bottom of the well is 3 feet below the river bottom and the motor and pump are located in a 12x12-foot house above ordinary flood level. The pump has a capacity of 1,800 gallons per minute against an 85-foot head and discharges through an 8-inch line supplying various branches and reduced to 6 inches at the riser to the dump box.

Concrete Mixing

It was discovered by careful hand screening that the run-of-the-pit in the bank opposite the plant location was clean and of sufficiently uniform and satisfactory composition to be used for concrete without other treatment than the forking out of boulders. It was accordingly delivered in a side dump car of 20 cubic feet capacity running on a narrow-gauge inclined track to a receiving platform about 25 feet above the surface of the ground and adjacent to a 6 x 6-foot tower with 4 x 6-inch corner posts guyed with 5/8-inch steel cables. A 3/4-yard concrete mixer mounted on a concrete foundation at ground level was charged from a measuring hopper about 12 feet above grade, under the receiving platform and delivered to a bucket hoisted in the tower by a two-drum 16-hp. engine and discharging to the forms through the chutes of the spouting system. This arrangement was considered very satisfactory and economical, and made possible the mixing and spouting of concrete at the minimum cost of 32 cents per cubic yard for the concrete bins and at a maximum cost of 58 cents per cubic yard for column construction.

The boilers for the mixer and hoisting engine were arranged as a battery unit and steam was made in either or both. They also supplied steam for the duplex pump which provided the water supply for construction purposes and trained the cofferdam.

Foundations

The column foundations were carried in open cofferdams through the gravel, through a 4-foot layer of clay and through an underlying stratum of quicksand to hard gravel at a depth of 12 feet below the yard grade. Considerable difficulty was experienced from running sand and from the water boiling up in the bottom, notwithstanding which the excavation was made at a cost of only $2.08 per cubic yard, including the cofferdams and pumping. Both hand and steam pumping were maintained continuously during the time of excavation and concreting up to yard grade. The cofferdam sheet piles were removed from the column footings, but remained permanently around the largest area containing the crusher foundation. The excavations around the columns were back-filled with clay and gravel well mixed and compacted.

The work was done under the supervision of the designing engineer, Mr. C. W. Knight of Cincinnati, and the owners' representative, Mr. Harry Donnelly. The owners supplied the construction plant and equipment and no contractor was employed. The transmission machinery was furnished and installed by the Webster Manufacturing Co. of Tiffin, Ohio.

CERESIT COMPANY EXPANDING.

The Ceresit Waterproofing Company, of Chicago, has had a wonderfully successful season, and is planning for the handling of still more business next year. One anticipatory move has been the transfer of the offices of the company to larger, lighter and in every way more satisfactory quarters in the new Westminster building, at the corner of Dearborn and Monroe streets. Another most commendable move has been the addition to the staff of Mr. Frank Adams Mitchell, formerly with the Chicago Belting Company. With this latter company Mr. Mitchell held the position of advertising manager, while with the Ceresit Waterproofing Company he assumes the position of vice-president.

Mr. Mitchell is every inch a salesman, and will have direct charge of the sale of Ceresit. Mr. P. H. Hansen, who formerly held this position, will remain with the company in the responsible office of treasurer.

Mr. Mitchell is an apostle of the progressive school of salesmanship. He insists on having a good product to sell, and then he puts quality before everything else. He has studied salesmanship as a profession, and it is safe to say that he would not have been asked to take his present position if he had not already demonstrated his efficiency in sales work. He is a college man, educated in Bucknell University, and has been an active member of the Chicago Association of Commerce, having been vice-president of the Glee Club and a member of the Ways and Means and Trade Extension committees of that influential body. During the past year he was made vice-president of the Leather Belting Club of Chicago.

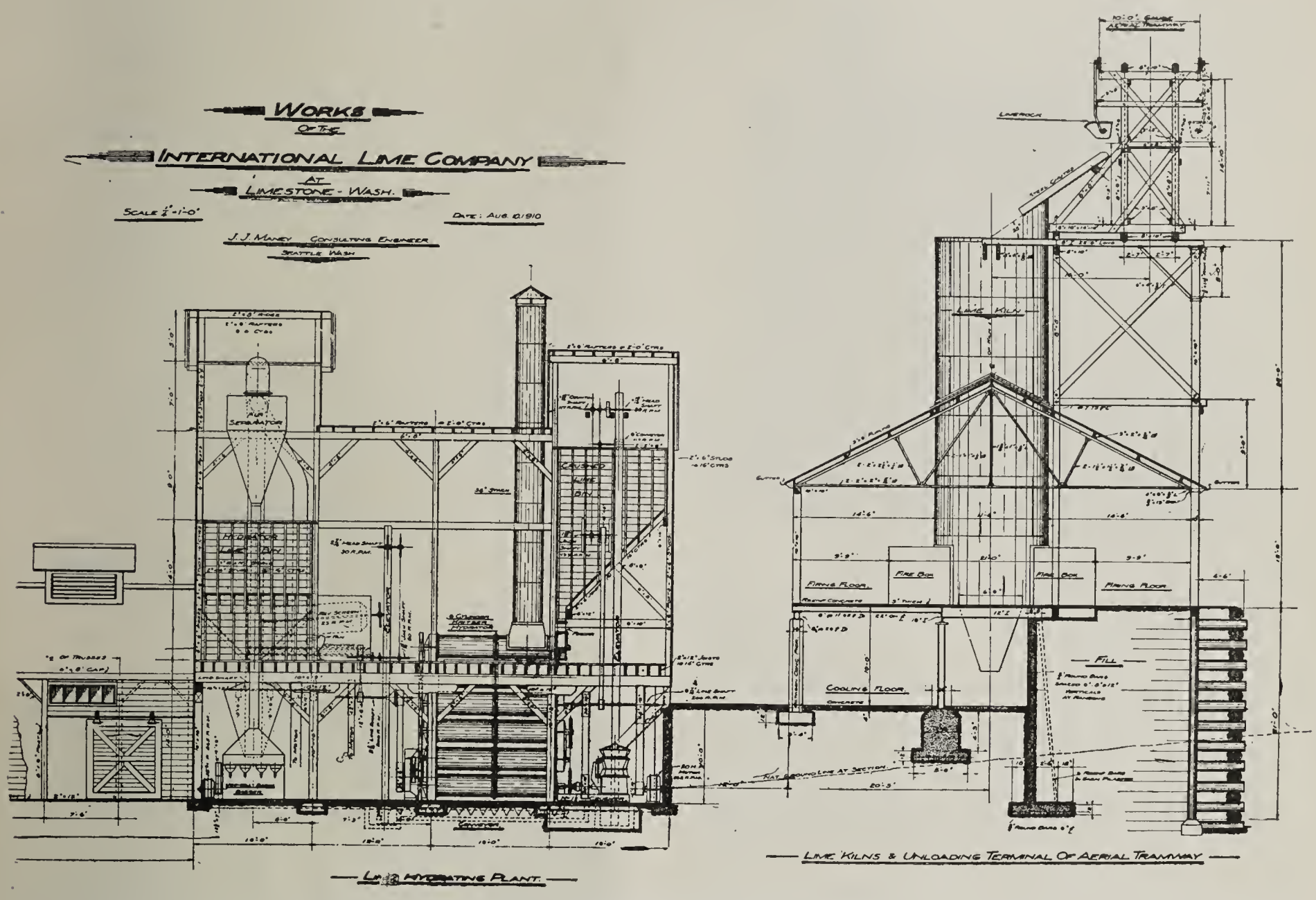
CONCRETE STRUCTURES

It was impossible to pass through the region of the spring floods without noting remarkable examples where concrete structures showed their permanence. One of the most remarkable examples was the Beaver Power Company's building at Dayton, Ohio, which was in the path of the destructive fire which threatened to wipe out that portion of the city to which the residents had fled for safety from the flood. In the path of the flames was this one building. Its frame was of reinforced concrete, its window sash and its floors of concrete. There was nothing to catch fire. The building formed a perfect fire wall and prevented the spread of the flames. Had the floors been of wood joist construction it is probable that the flames would have passed through but, in spite of the concrete floors becoming so hot that water sprinkled on them turned to steam, the absence of inflammable material was a perfect check.

This building was completed in 1910 by the L. P. Hazen Company, contractors of Cincinnati and was designed by Schenck & Williams of Dayton.

The Manufacture of Hydrated Lime

Considerable attention has recently been given in engineering literature to the production of a staple hydrated lime. Various products of this type have been on the market for a number of years. The methods used in the preparation of hydrated lime vary from a mere sprinkling of the lime and subsequent grinding of the slaked material, to complicated saturation and air separation processes.



A section through plant of the International Lime Company. Raymond pulverizing and air separating system, manufactured by Raymond Bros. Impact Pulverizer Company, Chicago, used in this plant.

The latter principle is employed in the plant of the International Lime Company at Limestone, Washington, on the Bellingham Bay & British Columbia railroad, in the Kendall district, east of Sumas in Whatcom county.

The deposit of limestone is 2,000 feet long, 1,500 feet wide, and has a face opening of 125 feet. A prospect tunnel at the present working level was run for 100 feet through solid limestone, remarkable for the absence of any seams. Samples were taken for analysis, of which the following represent a fair average:

Calcium carbonate	97.58%
Magnesia	0.36%
Silica	1.32%
Iron and alumina	0.50%

The quarrying is done by blasting and sledging, after which the rock is loaded on cars and dumped into the quarry bunkers.

From the bunkers the rock is fed through metallic chutes into the buckets of the aerial tramway.

The latter is made by the A. Leschen & Sons Rope Company of St. Louis. It consists of a lock coil cable 2,000 feet in length with a vertical elevation of 1,100 feet. It is operated by gravity from the upper terminal by a series of five brakes. The buckets automatically attach and detach themselves at the respective terminals and are discharged by an automatic tripping device. The present capacity is 25 tons per hour with a possible maximum capacity of 75 tons per hour.

The lime kilns are of the type designed and manufactured by the Mutual Engineering Company of San Francisco. The shell consists of 3-16-inch steel, is 40 feet in height and 10 feet in diameter, with a capacity of 70 tons of limestone. The lower portion tapers to a cooling cone with an 18-inch outlet, controlled by a geared draw gate operated by hand wheels. The lining of each kiln consists of Harbison-Walker Refractories Companies' "Woodland" fire brick set in front of "Silocel."

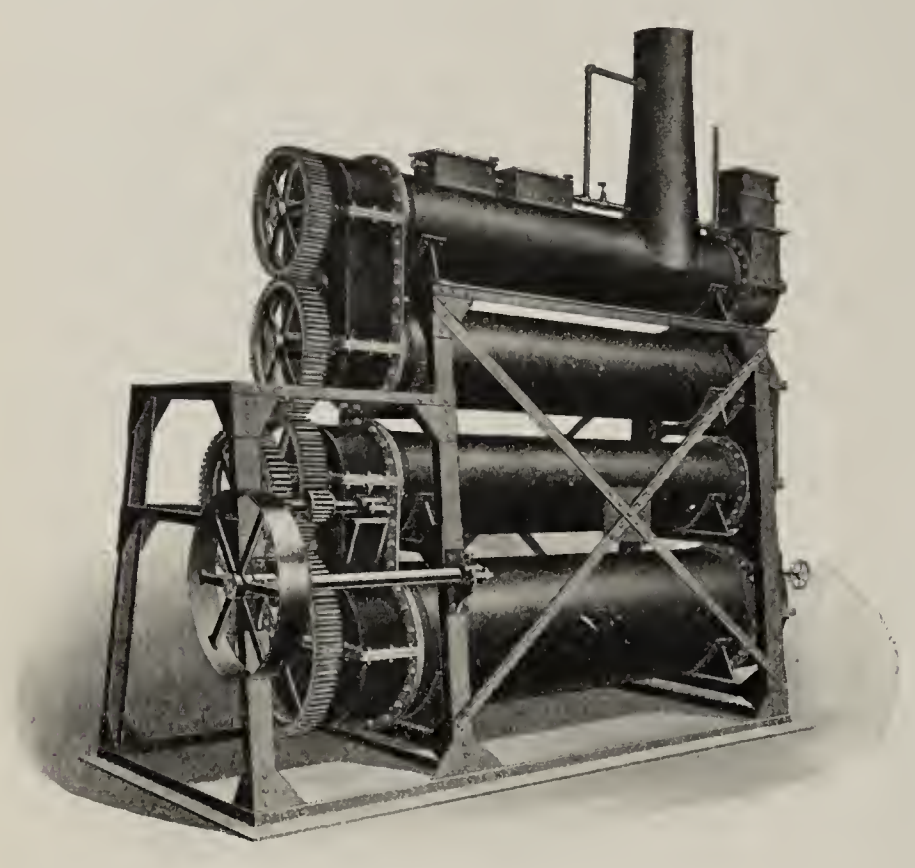
The fuel used in the plant is wood cut from the company's adjacent properties and the firing is done through four fireboxes with cast iron fronts.

The burned lime is drawn every four hours and dropped upon a concrete cooling floor, each kiln yielding about 110 barrels of lime.

The kilns are roofed over by a steel trussed roof with an umbrella-like structure protecting the kilns at the roof line.

The lime, after cooling, is wheeled to a Sturtevant No. 1½ crusher where it is reduced to pieces less than three-eights inch in diameter. It is then elevated 43 feet by a steel dust elevator and distributed by a screw conveyor to storage bins of 25 tons capacity each.

From these bins the crushed lime is fed by means of a geared gate into the Kritzer hydrator. This apparatus consists of 6 cylinders connected with a 40-foot stack, water jacketed for 30 feet. The water in



Kritzer hydrator.

this way becomes heated by the gases to 110 degrees F. Each cylinder is arranged with a screw which moves the material in a direction opposite the flow of the gases. The water supply is carefully regulated, about 30 lbs. of water being required per 100 lbs. of lime.

The hydrated lime is next discharged into a screw conveyor 28 feet long, elevated 30 feet by a chain bucket conveyor to the second floor and discharged into a hexagon revolving screen, where all material of three-eighths inch or larger is separated and rejected. The rejects consist either of core (unburned or overburned material).

The fine material passing through the screen is fed into a Raymond scalper running at 2,700 revolutions per minute, which throws it upward into the suction of a Raymond cyclone fan, running at 1,700 revolutions per minute, which forces it through a pipe 30 feet long and 18 inches in diameter to the dust collector. It is next discharged by gravity to the hydrate bins of 10 tons capacity, and from which it is sacked for shipment.

All material which is not moved by the fan is rejected and drops to the first floor.

The sacking device consists of an Urschel-Bates automatic valve bagger, with a capacity of 500 sacks per hour, and is operated by two men. The paper sacks are made by the Urschel-Bates Valve Bag Company and are sealed airtight, each sack holding 40 lbs.

The power installation is entirely electrical, utilizing the current from the main transmission line of the Whatcom County Railway & Light Company's plant at Nooksack Falls. It is a 3-phase system stepped down from 38,000 volts by two transformers to 440 volts. The motors are of the General Electric type, with automatic governors, and consist of one 35 h. p. motor for the air separator system; one 15 h. p. motor for the hydrator and elevator; one 15 h. p. motor for the crusher and elevator; one 15 h. p. motor for the bagging machine, and one 7½ h. p. motor for the dust collector, making a total of 87½ h. p.

The plant is connected with the B. B. & B. C. railroad by a mile-and-a-half spur and switching track. The road connects with rail and water transportation to markets at Sumas and Bellingham.

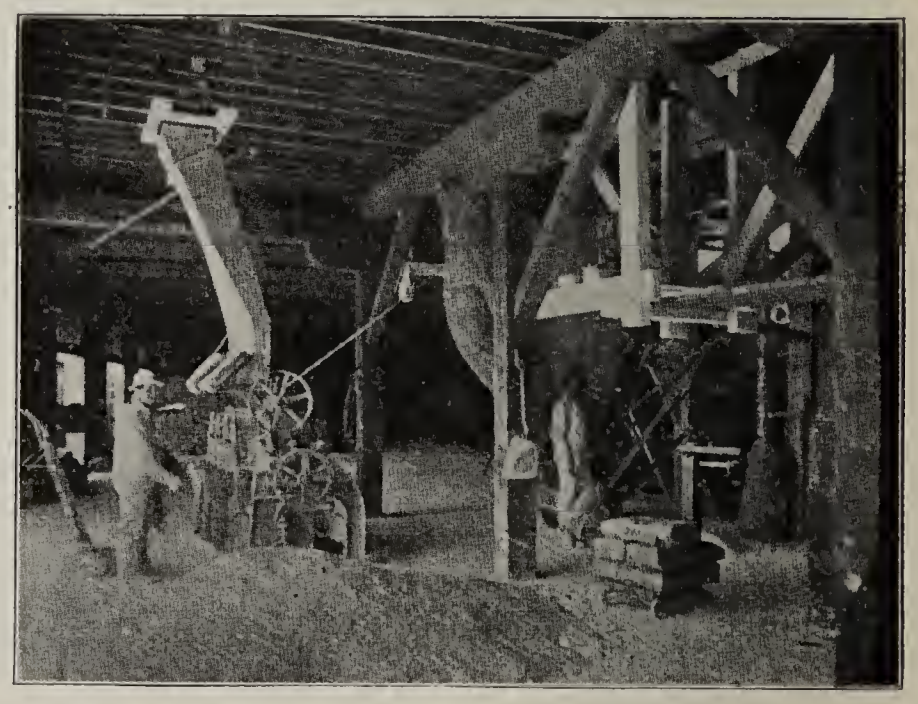
The buildings consist of a 3-story hydrating building 48x32 feet, with reinforced concrete retaining walls 10 feet high, on two sides; a warehouse 40x80 feet, and the two steel-trussed kiln structures already described.

Provision has been made to install a rock crushing plant where the crushing, grinding and screening may be done in succession through a distance of 83 feet, the feeding being done by gravity throughout.

The main product of the plant is a hydrated lime containing 97.3 per cent calcium hydroxide, no calcium carbonate, and no free lime; the remaining 2.7 per cent being mostly alumina. In fineness 100 per cent passes a 100-mesh sieve and 98 per cent a 200-mesh.

In the Kritzer hydrator no injurious heat is developed owing to the action of the back draft and the constant agitation of the material by paddles which move it quickly away from the direct action of the water. It is claimed for this process that, owing to the low temperature under which hydration is performed, the plasticity of the lime particles is not interfered with and the crystallization due to excessive heat by the sudden application of water, is entirely obviated.

After traveling 84 feet in a zig-zag course through the hydrator, the passing of the material to the Raymond mill, and through this mill, is accompanied by the cooling action of heavy air currents, which not only reduce the temperature of the hydrate, but assist in breaking it up into the finely divided flour in which condition it ultimately reaches the storage bin for the finished product.



Urschel-Bates sacker and Raymond mill.

The material rejected from the air separator consists of coarser hydrated lime with a kernel of free lime enclosed. It is proposed to use this material as

a lime fertilizer. No use is made of the rejected material from the screen, although undoubtedly it can be utilized as a fertilizer by grinding.

The product of the limestone grinding plant will be employed as a road material in the construction of the "Rocmac" macadam. In the main this macadam consists of fine limestone from ¼-inch size to dust, thoroughly impregnated with a chemical binder, placed on the rolled surface, followed by coarser trap rock, or other road metal, and rolled until the grout from underneath is forced up through the interstice. The grouting is brushed to the center and sprinkled with dry limestone to absorb the excess solution. The use of "Rocmac" macadam is very satisfactory, and has proved successful in experiments conducted in England.

The uses of hydrated lime are familiar to the building and engineering profession as a safe, non-deteriorating lime product. As a constituent of hard finish plasters and of waterproofing mortars its qualities are well known.

The use of lime as a fertilizer in the Greater Northwest is highly recommended as a fertilizer both by the state Agricultural experts and by the U. S. bureau of soils in their latest bulletins. These recommendations are based on the fact that the lime content of Western Washington soils is very low. In the past no proper lime fertilizer has been procurable locally. The plant at Limestone was first established in June, 1909. One year was required for survey. In July, 1910, construction began, and on May 25, 1911, the plant began operation. The organization is well manned, having for its factory superintendent, Geo. T. Kinder, formerly with the Kritzer Company, of Chicago; Stuart Mannell as general manager, J. J. Maney as consulting engineer, and Corwin D. Smith as chemical engineer.

GRIFFIN MILLS

In a recent communication W. A. Gibson, of Bradley Pulverizer Company, 92 State street, Boston, Mass., states that his concern has just shipped five Giant Griffin mills to the Great Western Portland Cement Company, at Mildred, Kan., which will be used for the the purpose of pulverizing cement clinker. The Great Western people are following the lead of many of the newer and larger cement companies who are using the Giant Griffin mill in all departments. This mill is used more extensively on the finish end on account of its economy and fineness of grind. Mr. Gibson states that "statistics compiled from reports on several large plants show that the Giant Griffin mill requires from 60 to 70 H. P. when grinding from 10 to 13 barrels per hour, and the upkeep is a little over one cent per barrel. One of the largest cement manufacturing companies in the United States is using over 50 Giants; another using 31. This speaks for itself, but we are quite anxious to have the cement manufacturer communicate with all users of Giant Griffin mills and procure from them their opinion of this mill as a cement material pulverizer, especially on the finishing end. List of installations will be furnished to any cement manufacturer."

SAND-LIME BRICK

Wright Brothers' factory, at Dayton, Ohio, where the first successful flying machines were made, and where the newest developments in aviation machines are being perfected, is built of sand-lime brick, manufactured by the Crume Brick Company.

BUILDING SILOS "FOR KEEPS"

We have on the Stevens Farm which I manage, three concrete silos, one sixteen by forty and two twelve by forty all of the monolithic type built by the Polk System. They are a solid six-inch wall and each is reinforced by 1,000 lbs. of cold twisted steel running both ways. There are within a radius of eight miles of this city at least twelve other concrete silos of this same construction and every one is standing in perfect order and giving perfect satisfaction to each owner. Three of these silos were erected two years ago and the others were put up last year, writes Geo. A. Fox, Secretary, DeKalb, County Farmers' Club, Sycamore, Ill.

Concrete silo built for Wilson Bros. & Son, Sugar Grove, Ill. This is the highest silo on record and is 16 feet in diameter and 64 feet high and has a capacity of 400 tons. It was filled five feet above the walls (has no roof) in a very little over 3 days and the owners declared they were sorry it was not 75 or even 100 feet high after it was demonstrated how easy it was to fill. It was built with forms manufactured by the Polk-Genung-Polk Co., of Fort Branch, Ind. W. H. Warford, Geneva, Ill., was the contractor.

We also have two stave silos on the Stevens Farms which were put up two years ago. The ensilage keeps just as good in the concrete as in the stave silos. We would not consider putting up anything but the solid concrete. We have heard that concrete silos would not keep the ensilage but know from our own experience that they will where the concrete is properly mixed. We have had no spoiled ensilage and find it just as good around the edges as in the center of the silo.

I do not know of any disadvantages with the concrete silo.

The monolithic type of concrete silo, or the solid reinforced concrete built with regular forms, manufactured by the Polk-Genung-Polk Company of Fort Branch, Ind., is the most substantial and durable silo that can be made and the cost is not excessive where a number of men build such structures in the same

community, thus enabling them to purchase the forms and distribute the expense between several using them, writes Ed. H. Webster, Dean and Director of Experiment Station, Kansas State Agricultural College and our experience is that there will be more and more concrete silos built as the farmers understand their durability and contractors over the country become familiar with this type of constructive work.

Under our climatic conditions, particularly in the western two-thirds of Kansas, the cement silo could not but help being a much more substantial form than the stave silo. The trying conditions of the weather, high winds, and extreme dryness of the atmosphere make it very difficult to keep the stave silo in proper condition, and I believe that the concrete form will entirely supersede the stave silo in that region.

Whether you hire an experienced contractor or do your own work should make no difference in the material. Concrete alone makes a silo that is yours "For Keeps."

For the farmer who is figuring on building several silos, or whose neighbors will co-operate in buying one set of forms, or for the contractor who is thinking of taking up silo building, there is real economy in buying the best outfit procurable. One that is bringing good results in the hands of both contractors and farmers is the Polk System of forms sold by the Polk, Genung Polk Co., Fort Branch, Indiana. A short description will show the ease with which a silo may be built with these forms.

First, a four-inch center mast of steel pipe is set up in the center of the silo floor and guyed perpendicular. A pipe collar with flanged hubs at each end slides on this mast and on it are supported, first,—the sheet steel forms, second—a swinging arm on which the concrete bucket is hoisted and from which it is dumped, and third—a working platform. The collar is free to move up as the work progresses.

To support the collar and to raise it after each day's work another flanged hub which also slides on the mast and which may be held at any height by keys fitting into slots in the mast, supports jacks which bear against the lower flange of the sliding collar. Thus the platform, forms and hoist can be moved up easily as work progresses. No scaffolding is required. The sheet steel forms are made in sections stiffened by angle irons bolted and wedged together before filling with concrete. Loosening the bolts and wedges after the concrete has set allows the forms to swing free ready for hoisting to the next position. Spacers are fastened to the forms to hold vertical reinforcement and the horizontal bars are fastened to the verticals.

The makers claim that raising the forms after each four-foot ring has set, takes but a few moments and that three men can build a sixteen by forty foot silo complete except roof, including all excavation, erection and dismantling forms in fourteen days.

The Polk Silo doors, unlike those commonly used, consist of oval manholes twenty by thirty inches, closed by sheet steel doors on the inside. The doors are held snug by wooden bars bolted on the outside and are sealed against air by a thin layer of clay for a gasket.

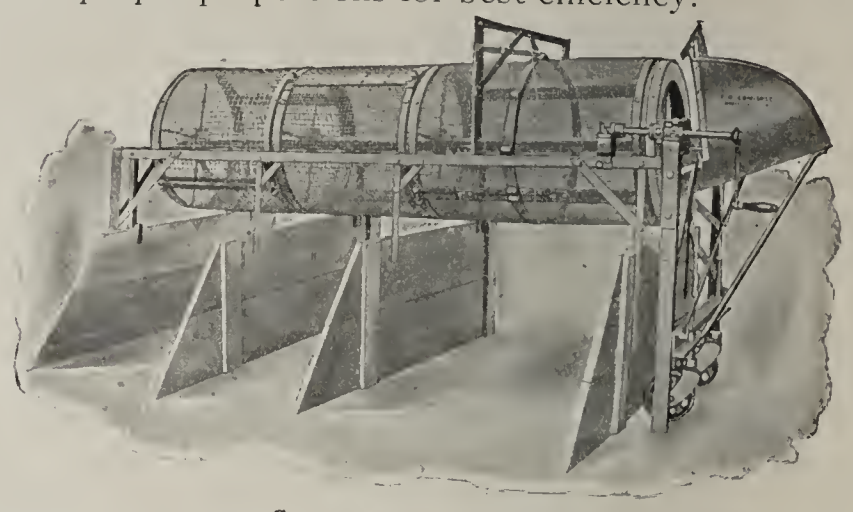
CONCRETE TILE FACTORY

Newton, Miss.—A new manufacturing enterprise that has just been put in here for the purpose of making tile drain from sand and cement is the Newton Tile factory, owned by N. and G. L. Doolittle and J. M. Still, well-known planters of this community. The plant has a capacity of 4,000 feet daily, and is now in operation.

WELL-GRADED AGGREGATES

At present more attention is paid to the careful grading of sand, gravel, and crushed stone for making concrete, than formerly. Test with different grades and mixers of aggregate have shown that it is cheaper and more satisfactory to balance carefully the sizes of aggregates in a mass so that the voids and spaces between the larger particles are filled with smaller pieces of the same material, than it is to attempt to fill all of the spaces with cement.

The contractor or builder who does this cheaply, easily, and successfully uses a rotary screen to aid him in sorting his materials so that he may again mix them in the proper proportions for best efficiency.



Converse Rotary Screen.

Converse Rotary Screen for Separating and Grading Aggregates

The rotary screen shown in the cut is manufactured by F. S. Converse. If we were to analyze this machine, we should find that each section is made of two half-sections, attached to the cylinder by only 6 bolts, so they may be easily changed to those having other sized spaces. The sections are interchangeable.

The partitions are removable by turning the turn-buttons on the posts. (Purchaser makes partitions from any rough boards.)

To run by power, remove the crank and substitute a pulley. Crank is located at feed end at a comfortable height, enabling one man to operate, if desired, by alternately filling hopper and turning crank. Chain transmits the motion from a small sprocket on crank-shaft to a large sprocket on main shaft, thus taking less power.

If desired, these screens are furnished with electric motor mounted on the screen frame. Prices will be submitted on application to the manufacturer. Address, F. S. Converse, care of Cement & Engineering News, 1117 Schiller Bldg., Chicago.

COMPRESSED AIR FOR PLACING CONCRETE

The Kansas City Terminal Railway has been successful in using compressed air for mixing and placing concrete on what is probably the largest job to which this method has been applied. The O. K. Creek sewer is circular for several blocks of its total length of 6,160 feet and a double box for the balance. At the middle of the sewer is a tunnel 1,230 feet long through rock. The tunnel is lined throughout with concrete 8 inches thick at the invert and 18 inches thick at the crown.

A pneumatic conveying concrete mixer was used first to place concrete in the open cut to demonstrate its efficiency and then used in the tunnel. Concrete was forced a distance of 450 feet with entire success. The pneumatic conveyor is especially well adapted to placing concrete in otherwise inaccessible positions. By careful manipulation an excellent quality of concrete is obtained and the rate of tunnel lining is comparatively rapid. In this work 11½ feet per working day was the average.

CONCRETE SILO NEWS

C. Fisher of Three Rivers, Mich., built six concrete silos in 1911, thirty-six in 1912 and by April 1st, 1913, had fifty contracts for this year's business and hopes to close many more.

Martin Taylor of Brown City, Mich., has contracts to build twelve concrete silos this year and expects to close more contracts. He and another contractor in the same town are responsible for 125 splendid concrete silos between Marlette and Port Huron, Michigan.

A former member of the teaching staff at the Iowa State Agricultural College, Mat King, says, "With a thoroughly solid foundation there is little danger of a concrete silo being damaged by settling. Such a silo could be set on three jackscrews and would stand 'until Kingdom come.'"

Dean Russell of the College of Agriculture of the University of Wisconsin says, "We believe in the silo in Wisconsin. Any silo which is capable of providing an air-tight structure will insure silage-keeping qualities. Concrete is unquestionably the most durable structure that can be secured for this purpose."

Twenty-eight farmers in the vicinity of Albert Lea, Minn., milk 455 cows. Not one of them has a silo. An investigation (by Hoard's Dairyman) of the profits to these twenty-eight farmers, and to their progressive neighbors who own silos, shows the startling fact that the twenty-eight without silos earned $33.70 less per cow per annum than their more progressive neighbors. Each farmer, therefore, lost nearly $550.00, or enough to buy a first-class concrete silo holding silage enough for 32 cows for 200 days.

If a silo adds $33.70 profit per cow in Albert Lea, Minn., it will do the same thing in Missouri, Illinois, Ohio, New York or wherever a dairy herd is looked to for profit.

John Kenhke of Reedsville, Wis., lost his barn and sheds by fire during May, but his concrete silo was undamaged. He will rebuild, using concrete for foundation and floor.

In the near future there will be constructed on a very large mule farm—near Kansas City, Mo., ten monolithic concrete silos in a row, each twenty feet in diameter by sixty feet in height.

The man for whom these silos will be built shows his appreciation of the value of ensilage as a food for mules by the following expression—"If I couldn't have ensilage I wouldn't be in the mule business."

METHODS AND RECORDS OF WINTER QUARRYING, USING ELECTRIC DRILLS

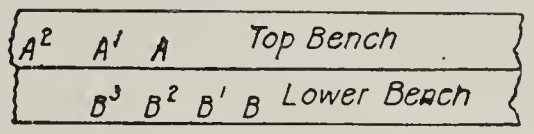
A great many quarries heretofore compelled to suspend operations with the advent of cold weather, due to the difficulties experienced in the operation of steam and compressed air tools, such, as the freezing of air lines, machines, etc., are having recourse to electrically operated tools attended by results which compare favorably with those obtained by the use of air or steam tools working under ideal weather conditions.

At the quarries of the Buffalo Cement Company, located at Buffalo, New York, winter operations are being carried on with electrically operated drills. Current for these drills is furnished by a Westinghouse 50 k. w. 220 volt, direct current, generator, direct connected to an Ames, 75 h.p. steam engine, running at 250 r.p.m.

The transmission line is carried into the quarry, 1,500 feet distant from the power house, where it is distributed throughout the quarry. In running the transmission lines, wooden poles with wooden cross arms and solid bare conductors are used, provision being made at convenient points for tapping.

The low cost of installation and maintenance of the electric transmission line as compared with steam pipe lines, forms quite an item in the economical operation of these quarries. Time and money spent in moving pipe lines, requiring the services of a skilled mechanic; the loss in transmission, leaky joints, etc., are a few of the difficulties which have been obviated by the installation of electric drills. Once installed the electric transmission line becomes practically permanent.

The methods of carrying on the drill operations are generally the same as those familiar in very nearly all quarrying operations, a few unique features, however, are especially worthy of note. The bench method is employed entirely—two continuous benches being worked varying in height with the lay of the rock. The accompanying sketch shows the method used to obviate any necessity for moving the drilling machines, which are of the 5C Temple-Ingersoll type from bench to bench. The top machine is kept constantly ahead of the lower machine; while the top machine is drilling at A, the lower one is drilling at B. A and B are blasted after moving machines to A^1 and B^1. During drilling operations at these points, the spoil thrown by blast onto the lower bench at B^2 is being cleared away. In this manner the time of moving machines about is greatly reduced.



—Shows Sequence of Drilling Holes.

The quarries of this company contain both limestone and a black flint rock of seamy formation, with a tendency to cave in places. The latter rock is extremely hard and difficult to drill.

The drilling is all done on contract. Each machine, of which there are five, is operated without a helper, one general utility man being employed to handle steels and otherwise assist in drilling operations.

The average drilling round in the limestone consists of from 10 to 20 holes, 8 to 12 feet deep. An average of from 100 to 120 feet of hole per day of 9 hours is drilled by each machine. Holes are started 2½ inches and bottomed 1¼ inches. Black powder is employed in this formation with copper exploders. Holes are tamped with a wooden bar and are shot by electric battery. But one drill is operated in this formation, where its work it intermittent, as it breaks more ground than the company has use for.

The lime rock products of this company are used for foundation and building stone. The serviceable sizes broken, being trimmed by hand to sizes carrying from 6 inches to 12 inches. From 3,000 to 4,000 tons per year are crushed and ground for local foundry trade, by which it is used as a flux. One grade, a honeycombed rock, containing a low percentage of lime, is crushed and ground for the fertilizer trade.

In the flint formation, holes varying in depth from 5 to 12 feet are drilled. The average round consists of 30 holes. These holes also are started 2½ inches and bottomed 1¼ inches. They are loaded with 12 to 14 sticks of 1¼-inch Keystone 40 per cent dynamite. The ground preparatory to being blasted is banked by rock already broken, experience having shown this to be a material aid in breaking it up small, as well as in restricting the spread of the blast. Four Temple-Ingersoll electric air drills are kept constantly at work in this formation.

The flint rock is used principally as ballast, in road building and as a filler for concrete.

An idea of the greater efficiency obtained through the use of the aforementioned drills may be gained by citing the statement of the superintendent in immediate charge, Mr. Fred G. Kuntz, that, with steam drills they were only able to obtain an average of 60 feet of drill hole per machine per shift, partly due to the delays, experienced with freezing of machines, lines, etc., whereas with the present drills they are obtaining an average of 100 to 120 feet under identical conditions accompanied by a saving in power of very nearly one-half.

During winter the operations in the quarries consist principally in the drilling, breaking and crushing of the various rock, preparatory to the commencement of mill operations in early spring. With the advent of spring, the steam shovel a Marion 60-ton machine, manufactured by the Marion Steam Shovel Co., Marion, Ohio, equipped with either a 1½ or 2 cubic yard dipper, and running on a standard broad gage track, is put into commission loading the flint rock into 2-cubic yard side-dump cars, following the work of the drills closely.

Rock which is thrown aside by the steam shovel is drilled by means of two small plug drills of the Ingersoll-Rand MV 5 type, air for which is furnished by a small power driven compressor manufactured by the same company. The problem of furnishing air to these drills has been accomplished in a rather unique manner—a narrow 36-inch gage flat car was pressed into service. The compressor, motor, water barrel and air receiver were mounted thereon and completely housed. This outfit follows the work of the shovel, current for driving motor being taken from the drill transmission line.

CONCRETE TANK CONSTRUCTION*

In its 1911 report the committee attempted to show what had been done up to that time in this particular field of concrete construction and to determine whether or not the concrete tank was practical and could be recommended for railway service. Examples of tanks built for railway and other purposes were given; specifications were quoted either wholly or in part, and it was shown that the concrete tank is practical and desirable where a permanent tank is contemplated. It is becoming more common to place the tank farther away from the tracks at railway stations and to deliver water to engine through pipe lines and stand-pipes, thereby making the water tank a more permanent structure. This decreases the necessity for a structure that can be moved on account of track changes and makes the concrete tank possible.

The two great arguments in favor of the concrete tank are permanence and minimum cost of maintenance. When the life of the tank is taken into consideration the latter will more than offset the increased cost of construction. The concrete tank is more costly than the wooden or steel tank but the steady increase in the price of lumber and the more improved methods of concrete construction are steadily reducing the difference.

The committee is of the opinion that when subjected to the severest winter weather the concrete tank will stand up better than tanks of other materials. The above statement is based on conversations with various engineers who have had experience in water supply, and at present cannot be substantiated by facts. However, some concrete tanks are located where they are subjected to severe freezing weather, and others are being considered so that it will not be long before this point can be determined definitely.

*Annual Convention; American Railway Bridge & Building Association.

Many arguments are advanced against the concrete tank, the chief one being that poor workmanship will result in a defective tank and this cannot readily be discovered or remedied. The statement is true, but it is also true of all other forms of construction. The remedy is careful, conscientious and competent supervision in selecting materials and doing the work.

Design

When contemplating the building of a concrete tank the design must first be decided upon. As the Association is more directly concerned in the construction work we will simply refer to the 1912 report of the American Railway Engineering Association, in which the subject of design and specification is very completely covered.

A distinct departure from the general design is a tank built quite recently in Australia. It is a hollow, inverted frustrated cone resting on a hollow cylinder or tower. The diameter of the water reservoir at the top is about twice that of the tower. While this is an odd looking structure, it has the advantage of reducing the weight on the foundation and it gives the maximum amount of water at the maximum head. This design may not appeal to most of us, and is introduced in this report because of its oddity, but it suggests the fact that it is not always necessary to confine ourselves to the old established and well beaten paths.

Material

There is no line of work in the broad field of concrete construction in which the care and judgment used in the selection and application of the materials is of more importance than in tank construction. Only cement of approved brands should be used. It should be delivered on the job in original packages and each consignment should be carefully tested. The sand, gravel and crushed stone must be carefully examined for impurities, and all such containing impurities must be rejected. The sizes of the various materials should be carefully considered and the proportions to be used determined in order that the resulting concrete will be as dense and watertight as possible. Much has been written of this particular feature in connection with concrete work in general, therefore, it is not necessary to elaborate upon it. Our purpose is to emphasize good workmanship.

Mixture

There seems to be a wide difference of opinion regarding the kind of a mixture that will produce the most compact and impervious concrete. Most specifications call for a wet mixture, yet occasionally a dry mixture is specified. In regard to the latter, Mr. L. Heidenreich says in his Engineer's Pocket-Book of Reinforced Concrete. "The author prefers for tanks a rather dry mixture of one part cement to four parts coarse sand well tamped. If a wet mixture is used the mortar or concrete is apt to contract in setting, thereby causing initial compressive stresses in the steel reinforcement. When the tank is filled the concrete will crack in various places until the steel receives its tension stress. This is the common cause of leaky tanks, which must be plastered or painted afterwards." The decision as to what is best must be left to the engineer and is controlled by the material available and his past experience.

Waterproofing

There are various methods of waterproofing concrete in use today, such as mixing a certain percentage of crude oil with the concrete or adding a paste, powder or lixiviating water to the concrete or mixing it with the cement, the mass of the concrete as a whole, or with the water. There is no doubt that any of these methods will produce an impervious concrete. However there is always a doubt whether the addition of

any extraneous substance to the cement will not in time injure the concrete.

With properly graded material and careful placing of the same it is possible to get a concrete that would not require more than an application of bituminous paint on the inside to prevent any seepage of water.

Cost

The concrete tank costs more than other tanks, but the first cost ought not to be the governing feature. A careful comparison should be made of different designs and styles of construction of tanks having the same capacity and serving the same purpose and the cost per annum in each case arrived at. The cost per annum is the average cost per year for the life of the structure.

The total cost is made up of the original cost of the structure: interest on the original cost for a period equal to the life of the structure; the total maintenance charges during the life of the structure; the interest on the maintenance charges from the time expenditures were made until the end of the life of the structure; and the risk or liability of destruction by storm or fire, whether covered by insurance or not. The total of these items divided by the number of years of life of the structure equals the cost per annum.

The building of concrete tanks is a comparatively new field and sufficient time has not elapsed since the last report to bring forth any new developments.

W. F. Strouse, assistant engineer, reports that the tank built at Sir Johns Run, W. Va., for the Baltimore and Ohio by the Steel Concrete Construction Company, has passed the severe winter of 1911-12 without showing any bad effects and that only a slight sweating or seepage has appeared.

Reinforced concrete tanks were mentioned which have been installed at Chicago on the Chicago Street Railways, at Norway, Michigan, and at Chicago Junction, Ohio.

SAND & GRAVEL COMPANY COMPLAIN

The Massillon Sand & Stone Co., Massillon, Ohio, has filed complaint with the state utilities commission against the Wheeling & Lake Erie Railroad Co. The allegation is made that the railroad company officials refused to furnish grain doors in accordance with a ruling of the interstate commerce commission. Because of this failure the sand company was compelled to build 60 of these doors before shipments could be made. The railroad company is asked to reimburse the sand company for the expense of these doors, and the utilities commission is requested to issue an order compelling the company to furnish these doors in the future.

CEMENT SHOW TRAFFIC MANAGER.

The Cement Products Company has announced the appointment of Mr. George Low as traffic manager for the seventh Chicago Cement Show. Mr. Low is an able and experienced traffic man. He will render the same kind of service to the exhibitors performed during the last several shows by his predecessor, F. E. Guy. Exhibitors are at liberty to avail themselves of the traffic manager's help and advice in shipping, rating, routing, tracing, teaming and delivery of goods for exhibition.

At the preliminary drawing for space practically all of the Coliseum main floor was assigned to exhibitors whose applications were filed before July 22.

THE YOUNGSTOWN PLANT OF THE TRUSSED CONCRETE STEEL COMPANY

This extensive plant of the Trussed Concrete Steel Company at Youngstown, Ohio, is devoted exclusively to the manufacture of steel products, such as United Sash, Kahn Trussed Bars, Hy-Rib, Rib-Lath, Reinforcing Steel and other building specialties. The waterproofing and finishing products of this company are manufactured in a separate plant in Detroit, while tile plants and warehouses, executive and sales offices are located in Detroit with representatives in all principal cities.

Six years ago only a few small buildings made up this entire plant. Today the factory and yards cover the greater part of twenty-five acres of land. The plant consists of an administration building, power plant, shipping yards, and a large number of individual buildings in which the various products are manufactured. In order to more clearly understand the development of this plant and its manufacturing divisions it is well to review the products of the Trussed Concrete Steel Company and their development.

Originally the Kahn Trussed Bar was the principal product of the company. The Kahn Trussed Bar is a patented reinforcement for use in concrete girders, beams, joists and floors, and consists of a main horizontal bar with rigidly connected diagonal shear members, formed from the same section of steel. Other reinforcing products were introduced shortly afterwards. These included the rib bar with a specially rolled section, so formed as to secure a positive grip in the concrete; rib metal, an improved type of expanded metal, formed from a special section of steel and consisting of a series of bars, rigidly connected by cross ties; column hooping, complete built up, and collapsible for convenience in shipping, etc.

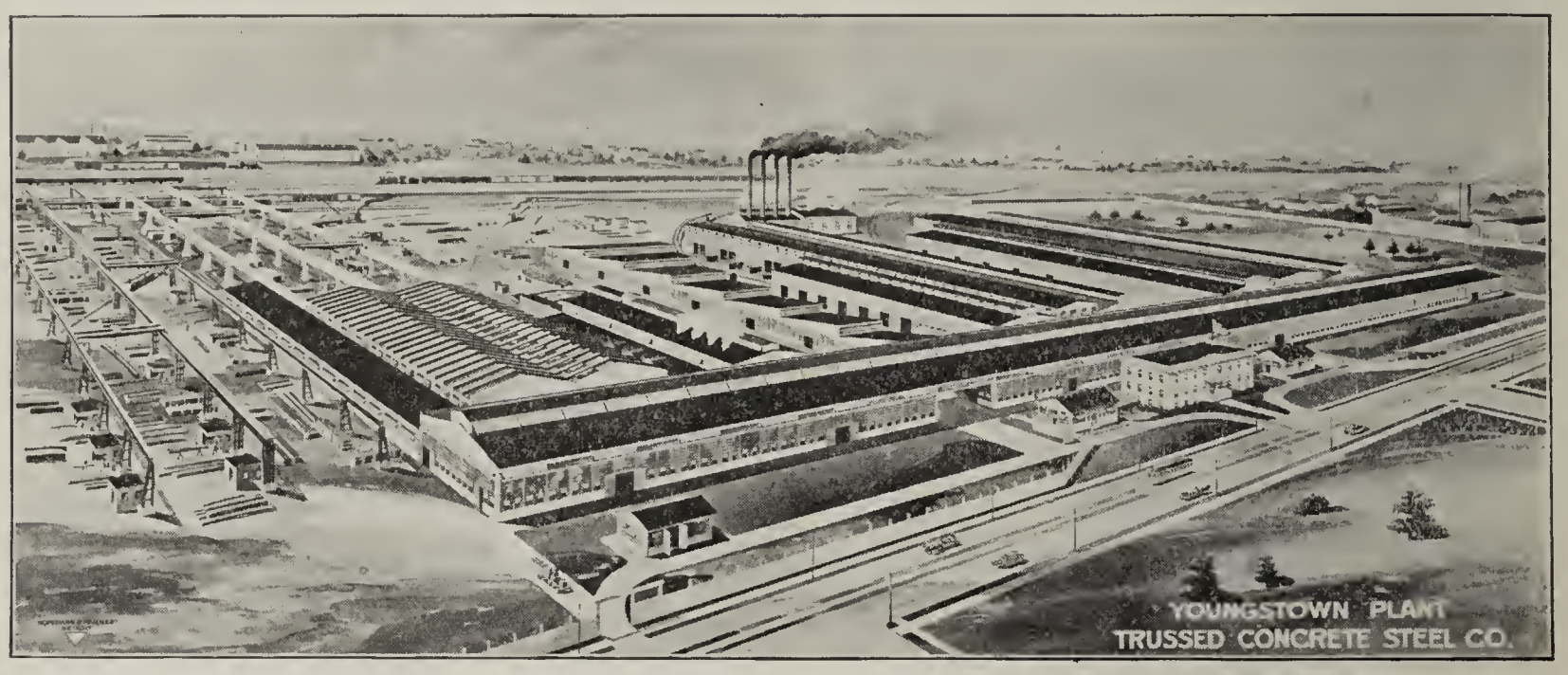
The next important development of this company was the invention of Hy-Rib, an entirely new type of reinforcement for concrete and plaster work. This material consists of a series of deep-ribs, connected by a specially expanded fabric, all formed from the same sheet of steel. The object of the ribs is to give stiffness to the reinforcement, so as to do away with forms when used in floors, roofs or walls, and to take the place of metal studs in partitions, sidings, ceilings, etc. Coincident with the invention of Hy-Rib, Rib-Lath, an improved expanded metal lath, which is on the same general principle of Hy-Rib, was introduced, as well as Rib-Studs for hollow walls and partitions.

The most recent development in the growth of the plant is the manufacture of United Sash for use in windows, monitors, partitions, etc. This steel sash is built on an improved principle of assembling, which gives exceptional strength and efficiency to the construction of the sash. All types of sash are made, including standard pivoted side wall sash, vertical sliding sash, center pivoted and top hung continuous sash, steel and glass partitions, steel doors, etc.

At the extreme left of the bird's-eye view is shown a portion of the shipping yards for the Kahn Bars and reinforcing steel, containing large cranes, stock yards, cut-off presses, etc. The shearing of the Kahn Bars is done in an adjoining building. Here are found presses weighing twenty-five tons each, and with a capacity of two hundred and fifty tons for forming the rigidly connected shear members of the Kahn Bars. The dies for shearing these Kahn Bars weigh about five thousand pounds each.

The rib bar department is in close conjunction with the Kahn Bars, and is completely equipped with shearing presses, bending machines, locomotive cranes, etc., to supply the rib bars in any form desired. The column hooping is manufactured also at this part of the plant. The rib metal material reaches the shop in the form of a wash-board shaped section, which is run through punches of three-hundred ton capacity, and is then expanded into the finished material.

The buildings for the Hy-Rib and Rib-Lath manufacture are the next adjoining and are provided with railroad siding, loading platforms, etc., for shipping purposes. In these buildings the flat sheets of steel are first especially prepared, beaded, trimmed and made ready for the punching press, which with special dies cuts the material as desired. The sheets go to the heavy forming presses, which by a process of pressing and expanding develop the products into its finished form. The Hy-Rib material is also furnished by the shops in curved sheets, the curving being done with special bending machines.



In the Floredome and Floretyle division, which is one of the recent developments, are manufactured deeply corrugated steel domes and tiles for use in floor construction in place of terra-cotta tile. These are pressed out under special dies and powerful presses to the desired form.

The general construction of the buildings is along the most modern ideas of fireproof and daylighted factories. Practically the entire side-walls are made of United Sash with a small curtain wall underneath of Hy-Rib concrete construction. The buildings are constructed with long span trusses, so as to give the greatest convenience in handling material, while the roofs are built of Hy-Rib concrete. Many of the buildings are provided with monitors, which are equipped with continuous United Sash.

This plant of the Trussed Concrete Steel Company is an excellent example of modern efficiency, both in equipment and construction. The general executive and sales offices of this company have their headquarters in Detroit, Mich., while the steel manufacturing plant is located at Youngstown, Ohio, for its convenience to the steel markets.

CONCRETE ROADS

Concrete Roads and Pavements is the title of a new text book of 228 pages issued by the Cement Era Publishing Co., 1207 Morton Bldg., Chicago. The price—$1.00—is a very small amount to pay for the illustrated information contained.

LUNKENHEIMER VALVES

The large sale of Lunkenheimer regrinding valves has demonstrated that steam users appreciate the fact that it is possible to secure in them a reliable valve, which can be repaired without disconnecting pipes, or incurring any expense other than the slight labor involved in regrinding the seating surfaces. When a steam user installs Lunkenheimer valves, the expense ends with the purchase of the articles. This is not true with valves in which to secure a new seat bearing it is necessary to purchase extra parts; therefore, as a matter of economy, the first cost of Lunkenheimer valves should not be the principal consideration.

The expense of disconnecting pipes and taking out defective valves is many times more than the cost of a good article, which, if installed in the first place, would render such expense unnecessary. Therefore, when installing pipe systems, it will be found better to purchase Lunkenheimer valves rather than the common grades with which the market is now flooded, writes the Lunkenheimer Company, Cincinnati, Ohio.

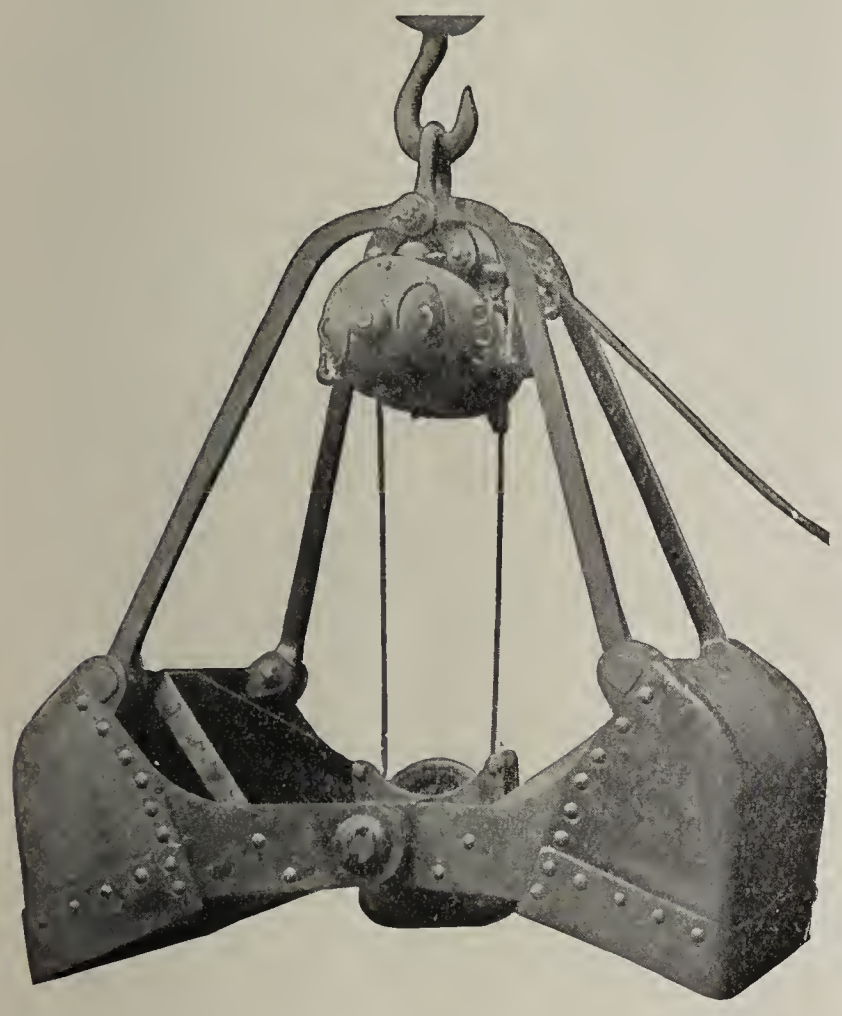
Many forms of valves have been placed upon the market, some of which have rubber, asbestos or copper discs, and while for ordinary pressure (say up to sixty or eighty pounds) such valves give fair satisfaction, yet when the pressures are above that, they lack durability. Aside from this fact, in order to renew the seat bearings in such valves, it is necessary to go to the expense of purchasing extra discs, the sale of which is controlled by the manufacturer of the valves. Valves will not give satisfaction when any part of the seat bearing is composed of metal whose melting point is below, or very near, the temperature of steam at one hundred pounds pressure. Copper disc valves will, in the course of time, prove unsatisfactory, for the reason that the copper disc, when subjected to heat for any period undergoes a physical change and deteriorates very rapidly.

Lunkenheimer regrinding valves are made of the only genuine steam metal bronze, an alloy which possesses the resisting and bearing qualities so essential to valve metal. One of the best proofs of their accurate and faultless design, and the correct principles of their construction, is the fact that we have been manufacturing them for upwards of half a century without any radical changes in any of their lines. Our constant endeavor, however, has been to improve the workmanship, quality and suitability of the materials used, until today we are in a position to challenge

anyone to produce their equal. The construction of Lunkenheimer valves comprises but few well-made parts, and there is an absence of machine screws, loose parts, or other devices of uncertain reliability and strength. The Lunkenheimer Company, Cincinnati, Ohio, have just issued a valuable and interesting booklet entitled "Regrinding Valve Booklet," which they shall be glad to send to any of our readers.

A CLAM-SHELL BUCKET WITH A SELF-CONTAINED MOTOR

A new development in clam-shell equipment is a clam-shell bucket which is closed and opened by a motor located under the bale of the bucket and controlled by a rheostatic controller. This motor controller is entirely independent of the operating machine, but under the perfect control of the oper-



ator. The accompanying illustration shows the general arrangement of this equipment, which is manufactured by the Hayward Company. The motor itself, with the drum, disc clutch and automatic stop, are all fastened to the upper head of the bucket by means of two bolts. The illustration shows the casing which protects the motor. Inside of these are located the motor, electric brake gearing, disc clutch and winding drum, all on a central shaft. Hand holes are provided at one end of the motor casing for easy access to the working parts.

The motor cannot be overloaded when closing, as the clutch is so adjusted that it slips when the bucket is entirely closed or when it grasps some object too large for it to handle. In the opening operation when sufficient line has been wound to open the bucket to its fullest extent an automatic stop prevents the opening and closing line from rewinding on the drum. In other words, the motor rotates, but the drum stands still when the bucket is wide open, no matter what position the lever on the controller may be in. This stop is positive in action, the dog or latch being thrown into engagement by the opening and closing line when the bucket is opened to its maximum spread. The rheostat type of controller is used arranged for two to four speeds either way. The current is conducted to the bucket by means of a small waterproof cable. This cable is taken care of on an automatic spring reel.

This type of electric motor clam-shell bucket can be successfully used on any machine and requires but one hoisting drum. In many places it is of great advantage to have the closing and opening of the bucket operated independently of the hoisting drum, For this and many other kinds of work, such equipment should be of the greatest value.

REGARDING CLOTH CEMENT SACKS

The following paragraphs are quoted from a large 14-inch x 24-inch poster which the Universal Portland Cement Company are supplying to their dealers to back them up in the campaign for taking better care of sacks:

We have to pay for cement sacks when we pay for the cement. They are not loaned or donated to us, therefore we cannot loan or donate them to our customers.

We will refund the money that our customers pay us for sacks if the sacks are returned promptly and in good condition.

We cannot sell back to the cement companies any sacks that are not fit for further use. If a sack has been allowed to get wet—if it is badly torn—or if it has been soiled or worn by use in handling other materials than cement, the cement companies will not buy it back from us. Therefore we cannot buy sacks back from our customers.

Cement is one of the few articles that are sold in packages with the privilege of returning the empty package for credit. The bottles, boxes, crates and tin cans that you buy are of little use to you after their contents have been used. Cement sacks are valuable because they may be sold back to us, if they are in good condition, but YOU must take care of them or stand the loss.

Cement sacks are too valuable to be given away, The returnable cloth sack is an economical package, but it is not a FREE package, and no sack can be repurchased which, FROM ANY CAUSE, is unfit for further use.

STABLE FLOORS

Since the common council of Hartford, Conn., passed an ordinance requiring stable floors of that city to be made of concrete, many inquiries have reached the Aberthaw Construction Co., Boston, regarding the suitability of this material for this purpose. Not content to rely upon its own extensive experience in this line, the Aberthaw Company has started an inquiry and will study the subject with the idea of settling once for all the claim made in some quarters that concrete is bad for horses' feet. Any special experiences in this connection, which might indicate either one side or the other of this subject would be gladly received by the Aberthaw Company and incorporated, so far as possible, in the report.

PRESTON K. YATES

Preston K. Yates, a well-known civil engineer of 30 Church street, New York, N. Y., has given years to the study of economies in the handling of raw material such as excavating, crushing and conveying rock, sand and gravel and such low-priced material, the value of which is determined by the cost of handling more than any other feature. Mr. Yates has made a marked success of many plants which formerly had very difficult problems in this particular line and his achievements have earned for him a position in these industries well recognized in all parts of the country.

Among The Cement Mills

SAND-CEMENT PLANT FOR CONSTRUCTING THE ELEPHANT BUTTE DAM

Experience at Roosevelt, Arizona, in constructing and operating a plant for furnishing cement used in building the dam had demonstrated the possibility of making a very material saving at other places. The net saving at the Roosevelt dam above the lowest bid price was nearly $600,000. The Federal Government is planning in the Rio Grande Valley, New Mexico, the most elaborate irrigation project in the world. There was material available near Elephant Butte for making cement, but the shorter haul and the lower price for cement made the saving by constructing a cement plant too small to justify the expenditure. Experiments were begun early and continued for a long time to determine the feasibility of manufacturing sand-cement from the material found at Elephant Butte which would be suitable and safe to use in constructing the dam. Estimates were made on the probable cost of producing this sand-cement, and it was finally decided that it would result in a saving of more than $200,000 to build the dam from sand-cement, and that the results obtained, both as to strength and density, would be in favor of the sand-cement. Accordingly, a sand-cement plant was designed by Mr. R. R. Coghlan, who was manager of the plant at Roosevelt, assisted by Mr. O. L. McIntyre and Mr. L. J. Charles. The machinery for this plant was purchased and the plant was completed ready for operation on March 1, 1913.

Rock from the sandstone quarry is delivered to a gyratory crusher. The product of this crusher goes to the bin above the ball mill either directly or through a rotary dryer, provided the rock contains enough moisture to make it necessary. The ball-mill product goes to the ground-rock bins. The cement is delivered by the railroad in cars which are spotted opposite hoppers and the sacks emptied into the hoppers. From the hoppers the cement is automatically conveyed to the Portland cement storage bin next to the ground-rock bin. From these bins the cement and ground sandstone are delivered by screw conveyors to an automatic mixer, which can be so set as to make the product delivered by it carry any desired proportion of sand to cement.

This product is carried by a mixing conveyor to a long conveyor running above the hoppers feeding the four tube mills. Gates may be so adjusted that each mill gets an equal feed.

The product from the tube mills is delivered into a long conveyor running along the end of and serving all four mills. This conveyor delivers its product on an inclined belt conveyor, which carries the sand-cement to the top of the storage bins. The automatic tripper delivers the product to any desired bin.

Gates are placed in the bottom of the storage bins discharging on a belt conveyor, which runs under all the bins and at the south end rises at an inclination sufficient to deliver the product to the small cement storage bin above the mixers.

The cost to date of this plant, including buildings, machinery and overhead charges, is about $56,000.

Crushing Plant

The crusher plant consists of two No. 7½ gyratory crushers, each having a capacity of from 100 to 150 tons per hour. Each one has an elevator for delivering its product into the storage bins above the mixing plant and is driven by a 100-hp. motor. The crusher platform is about 20 ft. lower than the track alongside of it. Trains of 6-yd. dump cars, loaded with rock from the quarry, are run alongside the crusher and the full trainload dumped into either hopper. As shown in the illustration, the gates which limit the supply to the crusher consist of rails handled by plungers moving up like fingers to prevent an excess amount of rock pouring into the crushers when dumped by the train from the quarry.

The product from one of these crushers is delivered into an inclined bucket conveyor, of a capacity of 100 to 140 tons per hour, and the other is delivered into a platform conveyor of the same capacity, which in turn delivers it to a vertical elevator. The product from each one of these crushers is delivered into a drum-screen the fines passing into the sand bin and the overs into the rock bin. Under normal conditions either one of these crushers will furnish the rock to the full capacity of the rest of the plant.

Over each crusher has been built a house to protect the men operating the crushers. It will require two men to feed each crusher when operating under normal conditions. The total cost of this crushing plant, including bins completely installed ready for operation, is $31,500. The depreciation cost charged against crushing rock on the assumption that the plant is scrapped when the job is finished, is 10.6 cents a yard and the labor cost is approximately 12 cents a yard.

As soon as the plant is operating at full capacity this labor cost will be materially reduced, as it will take practically no more labor to handle a greatly increased output.

GROWTH OF CEMENT INDUSTRY ON PACIFIC COAST

The cement industry on the Pacific Coast is a little more than twenty-nine years old. Its growth during this period was the subject of a paper delivered by Mr. Chas. A. Newall before the Pacific Northwest Society of Engineers. The speaker pointed out that in the late eighties and early nineties only two plants in California were making natural cement from argillaceous limestone. This product, however, was not trustworthy, being exceedingly irregular in quality.

The first plant to make true Portland cement of good quality on the Coast was built in Oregon, and it is stated that it was the first to use a rotary kiln successfully. In 1894 Uria Cummings planned to build a plant near Los Angeles, but as satisfactory transportation rates could not be agreed upon with the railroads the plan was abandoned. In 1898 the first plant to operate successfully was started by the California Portland Cement Company at Colton, 50 miles east of Los Angeles. Its initial capacity was 500 bbl. per day. The product was poor, and not until four years ago, when the new mill was built to increase the capacity to 2500 bbl. per day, and the plant was remodeled, was a high grade of cement produced.

In 1903 two plants were started—the Standard Portland Cement Company, at Napa Junction, and the Pacific Portland Cement Company, at Cement. Their products, Mr. Newell said, compare favorably with others on the market. The plants have been enlarged from time to time and in 1906 each company built a new mill.

In 1907 the Washington Portland Cement Company began operations at Concrete, in Skagit County, with a capacity of 800 bbl. per day. Three years later the capitalization was raised to $700,000, and the capacity was increased to 2500 bbl. per day. The next year, 1908, the Superior Portland Cement Company was started, the plant being not quite one-half mile away from the plant of the Washington Cement Company. The Superior is capitalized at $1,000,000, with an output of 1500 bbl. per day. In 1909 two plants were started—the plant of Riverside Portland Cement Company, at Riverside, Cal., with a capacity of 3000 bbl. per day, and the plant owned by the Los Angeles Aqueduct Commission.

In 1910 the plant of the Golden State Portland Cement Company was put in operation at Oro Grande —on the Mojave Desert in southern California. The plant is capitalized at $200,000 and rated at 1000 bbl. per day. In 1911 the Inland Portland Cement Company, a subsidiary of the Lehigh Portland Cement Company, of Allentown, Pa., began operation at Metalane, north of Spokane. In 1913 three new plants will be in operation—the International, just out of Spokane; the Olympic, in Bellingham, and the San Juan, near Watsonville, on Monterey Bay, California.

In the twenty-nine years since 1884 the cement industry has grown from the single plant at Oregon City, with its 100 bbl. per day capacity and $50,000 capitalization, to a total of thirteen plants capitalized at about $24,000,000 and with a combined output of about 38,500 bbl. per day.

NEWS ITEM

We are pleased to advise you that we have just received orders from the following cement companies:

The Wolverine Portland Cement Co.,

The Huron Portland Cement Co.,

The Cape Girardeau Portland Cement Co.,

for No. 2 Duplex and Single Ring-Roll Mills and Neway Separators for the preliminary grinding of their clinker, writes the Sturtevant Mill Company, of Boston, Mass.

The No. 2 Duplex Ring-Roll Mill has a usual output, taking a feed as it comes from the kiln, of from 80 to 90 barrels per hour, reducing it to 20 mesh for Tube Mill feed, or for grinding to 40 mesh it has an output of from 60 to 80 barrels per hour. The h.p. required for these outputs is approximately 90 h.p. The upkeep expense on these machines per year is about $600.

CEMENT MILL NEWS

The Henry S. Spackman Engineering Co., inspecting and chemical engineers, announces the removal of its Philadelphia offices and laboratories to its new building, 2024 Arch street, Philadelphia.

Standard Portland Cement Co., San Francisco, has sold 30,000 bbls. for use in western reclamation work. The contract price was $1.40 per bbl., f. o. b. cars at Napa Junction, Cal.

The Dewey Portland Cement Co., Kansas City, Mo., is installing electric drive in its mill at Dewey, Okla. The power plant will be equipped with a 1,125 kv.-a. generator, 150 kw. motor-generator set and switchboard; while two 75-h. p., four 20-h. p. and two 10-h. p. motors will be employed for driving the machinery throughout the mill.

There is nothing in Goodrich Advertising
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Buckets don't pull loose from Goodrich Elevator Belts. Here are belts with a duck construction that will hold the bucket bolts firmly in place under the heaviest loads and most severe working conditions.

GOODRICH Elevator Belts

are made strong and tough by a duck construction of special, hard, tight weave and heavy weight.

This duck construction gives increased tensile strength to the belt. It diminishes stretching to almost nothing. It provides firmer gripping power for the bucket bolts, and resists the entrance of moisture through the bolt-hole perforations.

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You can judge this belt better by having a sample before you. Give it a thorough inspection. Note the high-grade rubber friction which thoroughly penetrates the fine mesh of the duck and protects it from moisture.

Test the tough, resilient rubber cover which protects the duck from abrasion and cutting by small, sharp stones. Then judge for yourself the merits of Goodrich Elevator Belts.

Ask for our Elevator Belt booklet

The B. F. Goodrich Company
Makers of Goodrich Tires and Everything that's best in rubber
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TONS OF DUST FROM PLANT

Approximately 42½ tons of cement dust escapes every 24 hours from the eight stacks of the Cowell Cement works in Contra Costa county, California, according to the expert and thus far uncontradicted testimony of Professor Robert E. Swain in his testimony before the court at Martinez.

The figures which were presented in the form of charts by Professor Swain were truly amazing, says the Contra Costa Gazette, for while Contra Costa people know that there is a considerable quantity of dust escaping from the works while in operation very few realized that such a great quantity is daily being sent forth from the stacks and allowed to settle over the surrounding farming region. There are eight of the mammoth stacks at the plant and with all eight in operation and the plant running to capacity above tonnage escapes each day.

The tests were made by means of pilot tubes meters and mercury manometers to register the tonnage, velocity and quantity of the gases.

THE CEMENT SHOW

A glance over the list of exhibitors at the coming Chicago Cement Show indicates a marked increase in the number of firms making concrete equipment. The Show promises to give an unprecedented opportunity for the study of modern building methods and for careful and intelligent buying. The year has been a successful one in all branches of the concrete industry and this will be reflected in the exhibits.

CONCRETE BLOCKS.

The Pettyjohn Co., 545 N. Sixth St., Terre Haute, Ind., has just issued a new catalogue 9 in. by 6 in., paper bound, 48 pp., illust. The salient feature of the Pettyjohn block machine is the fact that the machine itself, a very small, compact mold, is taken off the block and moved to another pallet, instead of moving the block away from the machine. The catalogue, after describing Portland cement, its use and abuse, and the advantages of hollow concrete buildings, presents the essential features of the Pettyjohn machine. Different styles of block and different ways of handling the machine are covered in detail. Other equipment made by the Pettyjohn Co., such as fence post molds, sidewalk block machines, veneer molds, is described in this catalogue.

THE CONCRETE BLOCK HOUSE

The architect has felt that the field of good design with concrete blocks as a wall material has been somewhat circumscribed. The usual gray texture and plain face made by those block makers who have advanced far enough to drop the old rock faced pattern with its monotony, has hardly given the architect a sufficient range. This, however, seems not to be the fault of the material but the methods of construction, or rather the inability on the part of the block makers to realize the wonderful possibilities of the material. When equipped with block machines which permit the use of special facing aggregates there are possible unlimited variations of color and texture.

The May monthly Bulletin of the Universal Portland Cement Co., contains an illustrated article showing a residence in Evanston, Ill., built with concrete blocks of three distinct colors and textures yet obtained at a very slight additional cost over plain blocks. The house is one of creditable architecture, costing in the neighborhood of $7,000, and typical of a great majority of suburban homes, with a garage built in the basement and generous porches on both floors. That as attractive a building as this appears to be, is possible with concrete blocks is proof that the material is susceptible of much wider treatment than has been accorded by the average block maker and equally good results may be obtained by many architects if they understand what may be expected in this rather new material.

FOR SALE

A western firm writes us that they have placed upon the market an inexpensive machine for making concrete silo blocks. It is considered the best machine ever manufactured for this purpose. They are enjoying a good business at present but on account of other lines, which keeps them extremely busy all year, they are anxious to get in touch with parties who will make the machine for them and sell it on a royalty basis. Address Cement & Engineering News, 1117 Schiller Building, Chicago.

UPPER SECTION OF BANK IS BLASTED, THEN STRIPPED BY MEANS OF THIS GIANT PUMP AND HOSE.

VIEW OF
STONE QUARRY
AT THE PLANT
OF THE ST. LOUIS
PORTLAND CEMENT
COMPANY.

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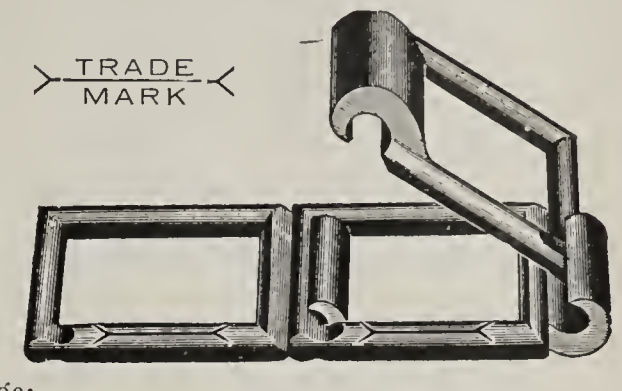
Manganese Steel Chains

Combined with ➤FLINT-RIM➤ wheels, make an ideal combination for *durability* and *service* in the handling of abrasive materials, such as cement clinker, ashes, crushed stone, ores, fertilizers, etc.

Manganese steel is famous for its *toughness* and *hardness* to *resist wear*, and special processes, mixtures and heat treatments have made it possible to furnish smooth and uniform chain links of the various types used for severe work.

Prices on our many sizes and styles furnished on request.



Write for the following Link-Belt Catalogs:

No. 90—400-page General Price List Catalog.
No. 124—Link-Belt Steel Chains.
No. 185—Ewart Detachable Link-Belt Price List.
No. 108—➤FLINT-RIM➤ Sprocket Wheels.

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INDUSTRIAL RAILWAY EQUIPMENT

Catalogue No. 900 of the Orenstein-Arthur Koppel Company contains a complete review of railway equipment, portable railways, industrial railways, narrow gauge sidings, narrow gauge public railways manufactured by the company and in use at thousands of factories in the United States and abroad.

The catalogue illustrates in detail on 80 pages everything imaginable for locomotives, railroad cars, steel dump cars down to turn-tables, switches and rails. Their material is known the world over for its excellent qualities, so that it requires no further comment.

Customers of the Orenstein-Arthur Koppel Company will welcome this catalogue as a suitable supplement to their fromer publications and manufacturers unfamiliar with their equipment are advised to send for it in order to become acquainted with the company's products.

NEW BOOK—CONCRETE BRIDGES

"General Specifications for Concrete Bridges" is the title of a new book by Wilbur J. Watson, 11 x 8¼ inches, paper bound, 66 pages, illustrated. Price $1. Sent on receipt of price by Cement and Engineering News, 1117 Schiller building, Chicago.

These specifications are intended as a general working basis for concrete bridge construction, and have met an actual need of the profession. Such specifications should be found especially useful where they are made the basis of competitive design. In such cases it would be possible to compare all design on an equal basis.

THE KENNY WELL-CURB MACHINE

L. T. Kenny & Son, Howarden, Iowa, have recently placed upon the market a Well-Curb Machine. This machine is made of best gray cast iron with strongly ribbed reinforcement which enables it to withstand hard usage. The end doors form the end of the curb block, with groove and tongue extension and depression forming a wall of interlocking units. Center cores form the outside of the block enabling the operator to make two perfect blocks at a time. These blocks are 2½ inches thick, 8 inches high, and 17 inches long. It takes six blocks to complete the circle, which is 2 feet 10 inches outside and 2 feet 5 inches inside diameter. Eighteen curb blocks make a wall 2 feet high. It is stated that one sack of cement mixed 1:5 will give 24 curb blocks; the manufacturers say, however, that in their plant two men have mixed by hand and moulded on their machine 24 curbs in 20 minutes, or at the rate of 720 curbs a day. Blocks made on this machine are well adapted for any circular opening; such as man-holes, catch basins, vaults, cess pools, water meter pits, area-ways around cellar windows, arches, cistern necks, etc., and are being extensively used for these purposes. For illustrated descriptive literature write L. T. Kenny & Son, Howarden, Iowa.

SAND-LIME BRICK

David A. Stevens, a consulting engineer of Chicago, has acquired a controlling interest in the Silica Products Company, owner of a brick and sand plant at Portage, Wis. It is understood that the plant will be enlarged and that new equipment will be installed.

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For more than fifteen years this brand has been specified by architects and used by engineers in work involving the expenditure of millions of dollars.

Our unique, forceful and productive helps for the dealers, are gaining favor every day.

Join the "Double A" class and get the "lion's share" of the cement business in your vicinity.

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Van Duzen Concrete Mixer

Price $165.00

This is a ONE-SIXTH yard mixer. Two wheel-barrow loads per mix. Daily capacity 50 YARDS. Mounted complete with 2½ H. P. Engine.

Manufactured under basic U. S. letters patent No. 782,700. BE CAUTIOUS, you are protected when you buy a Van Duzen.

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